HUMBOLDT-UNIVERSITÄT ZU BERLIN

Landwirtschaftlich-Gärtnerische Fakultät

"Determinants of farmers' compliance with the Nitrates Directive in Märkisch-Oderland – an exemplary analysis in the light of institutional compatibility assessment"

Master-Arbeit im Studiengang: Agrarökonomik

vorgelegt von: Anja-Kristina Techen

Betreuer:
Prof. Dr. Dr. h.c. Konrad Hagedorn
Institut für Wirtschafts- und Sozialwissenschaften des Landbaus, Fachgebiet Ressourcenökonomie

Dr. Insa Theesfeld
Leibniz-Institut für Agrarentwicklung in Mittel- und Osteuropa (IAMO)

Berlin, den 29.04.2009

Content

List of figures

List of tables

Abbreviations

CBA:	Cost-benefit analysis
CC:	Cross compliance
CIA:	Crucial Institutional Aspect(s)
LUA:	Landesumweltamt Brandenburg (Brandenburg State Office for Environment)
LVLF:	Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung Brandenburg (Brandenburg State Office for Consumer Protection, Agriculture and Land Restructuring – free translation)
MLUV:	Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg (Brandenburg Ministry of Rural Development, Environment and Consumer Protection)
MOL:	Märkisch-Oderland – the case study region in Brandenburg, Germany
N:	Nitrogen
ND:	Nitrates Directive
NVZ:	Nitrate Vulnerable Zone
PICA:	Procedure of Institutional Compatibility Assessment

Acknowledgements

First of all, I want to thank my supervisors Prof. Dr. Dr. h. c. Konrad Hagedorn and Dr. Insa Theesfeld. Especially, I owe Dr. Theesfeld and Christian Schleyer my gratitude for information, support and offering me constructive discussions about my research.
Special thanks go to all the farmers who took their time to talk to me even in summer when they had a lot to do. As well I thank staff from the Landwirtschaftsamt Märkisch-Oderland, the Landesumweltamt Brandenburg and the "Statistische Erhebungsstelle des Landkreises Märkisch-Oderland" for interviews, information and statistical data.
Also, I want to thank my family for their support and especially my brother Philipp Techen for helping a lot with the lingual and technical issues of the thesis.

Introduction

The master thesis on hand presents an ex-post analysis of crucial institutional aspects which determine the compatibility of the Nitrates Directive with the regional institutional context of the case study region Märkisch-Oderland, Germany. While the broad assessment of existing crucial institutional aspects was done as a pre-study, the focus of the thesis is on the analysis of the determinants of farmers' compliance behaviour.

The Nitrates Directive was chosen as an example for agri-environmental policies. To increase the chance that such a policy will be successful in promoting sustainable development in environmental, social and economic terms it has to be assessed beforehand. One important bundle of determinants of a policy's efficacy and its efficiency is how actors perceive and react to the policy which often is crucially determined, among others, by regionally specific determinants.

A way to support future ex-ante assessments is to gather knowledge from ex-post analyses of policy implementations. For this thesis, by analysing crucial aspects of farmers' compliance, information on what determines farmers' behaviour, and through which mechanisms it does so, was collected and evaluated in terms of its usability for ex-ante assessments. Thus, the thesis shall make a small contribution to shedding light on crucial institutional aspects for ex-ante policy assessments.

A pre-study was conducted which assessed the overall crucial institutional aspects of the region by applying the Procedure for Institutional Compatibility Assessment[1]. Based on the pre-study, in the following main study the focus on farmers' behaviour was taken, and the analysis of determinants of the same guided by a framework of plural rationalities. Methodologically, semi-structured interviews as well as literature and document analysis under consideration of mostly institutional economic theories were applied. The theories considered were mostly on the application of different rationalities; but also transaction cost economics, and some micro-economic issues were important for the evaluation of determinants.

This way, the analysis of a range of determinants of farmers' compliance with Nitrates Directive rules, discussed in light of their meaning for the implementation of agri-environmental policies and ex-ante assessments of the same, is presented in this thesis.

[1] This procedure was developed within the SEAMLESS (System for Agricultural and Environmental Modelling; Linking Euorpean Science and Society) project which was funded by the European Union within the 6th Framework Program, Project no. 010036.

1. Background, questions, and structure

1.1 Research background and research questions

This section's primary purpose is to help understand how the research questions of this thesis evolved, as well as to establish the terminology for the following chapters. For this, some basic ideas and concepts on policy implementation are briefly presented before specifying the research questions.

1.1.1 Institutional ex-ante assessment of policies

When policies and policy measures, as realised aspects of overall policies, are implemented, their effectiveness and efficiency – or cost-effectiveness – depends on many factors.

As for meeting the objectives of a policy like those introduced in the Nitrates Directive, one could look at two basic levels of success-criteria which can occur on several phases of the policy cycle: Firstly, the success of the policy measures depends on whether in the early stage of the policy cycle the basic idea behind it, and later on the concrete formalised rules, are, if fully implemented, leading to the desired policy outcomes. These are mainly technical questions in the wider sense. For example the question would be if it really leads to less nitrate in the waters, when the farmers apply less nitrogen fertiliser. Secondly, if the policy and rules are technically functional in this sense, the question would be whether initially the policy is actually transferred into useful rules, like limiting the allowed nitrogen surpluses in fertilisation, and finally whether the rules are then actually put into practice and complied with. For the ex-ante assessment of the latter issues, there are different approaches, but often dealing only with a limited range of aspects (THEESFELD ET AL. 2008).

A recent research project to develop an integrated framework for a comprehensive ex-ante assessment of agricultural and environmental policy options is the SEAMLESS project[2]. There, different quantitative economic and ecological models, complemented by some qualitative procedures, have been brought together in an integrated computerised framework to make comprehensive and interdisciplinary ex-ante assessments of policy options.

One of the working groups of the SEAMLESS project has dealt with the ex-ante assessment of the second level, i.e. whether policies and rules will actually be implemented in the way they are planned. The procedure which has been developed for this and is still undergoing further testing and development is called Procedure of

[2] The SEAMLESS (System for Agricultural and Environmental Modelling; Linking Euorpean Science and Society) project is funded by the European Union within the 6th Framework Program, Project no. 010036.

Institutional Compatibility Assessment (PICA). This is a procedure to facilitate the assessment of what are crucial aspects in a policy's implementation, how these aspects are shaped in certain regions, or other entities, and finally of the overall institutional compatibility of the policy with the institutional context, for example of a region.

While it is important to assess the institutional compatibility ex-ante, it is also important for future ex-ante assessments to take closer looks at the institutional aspects, to learn more about their determinants and their impacts. To contribute to this, in this thesis a policy is chosen in the context of which such aspects can be examined ex-post to draw conclusions for ex-ante assessments. The chosen example to investigate is the Nitrates Directive and its implementation in a region in Germany. The Nitrates Directive has also been a test case for the application of the PICA in several regions in France, therefore comparisons are possible. During research, the focus within the case study became the motivation of the farmers to comply with the policy rules and the behavioural logics, or rationalities which this behaviour is based on.

1.1.2 The concepts of 'Institutional Compatibility' and 'Institutional Aspects'

To elucidate the terms *institutional compatibility* and *institutional aspects*, which are adopted from the PICA project, it is required to first define the term *institution*. Subsequently the Institutions of Sustainability framework will be very briefly presented to facilitate the explanation of the concepts of institutional compatibility and aspects.

Institutions can be perceived as: *"the conventions, norms and formally sanctioned rules of society. They provide expectations, stability and meaning essential to humans' existence and coordination. Institutions regularise life, support values and produce and protect interests."* (VATN 2005a: 60).

Alternatively, with a stronger focus on the constraining aspects of institutions, it can be perceived as: *"the humanly devised constraints which structure political, economic and social interaction. They consist of both informal constraints [...] and formal rules [...]."* (NORTH 1991: 97).

So both, policies and rules, belong to the context of institutions – while a policy is evidently not necessarily an institution itself, it at least comprises sets of norms and rules or brings them about as policy measures.

The *Institutions of Sustainability (IoS) framework* is "*an explorative concept [...] to structure and analyse the relationships and the interplay between" "properties of transactions"* and *"characteristics of actors"* on the one hand and *"property rights to nature components"* and *"governance structures for agri-environmental relations"* on the other hand (HAGEDORN ET AL. 2002: 4). This framework can be perceived as looking at sustainability both positively - that is what institutions for sustainability there are, and how

they emerge and perform – and normatively, i.e. how they can be designed (HAGEDORN 2005: 11).

This way, among others, the IoS framework shows the areas, and hints to aspects, which jointly may account for whether and how a policy or concrete rules in nature-related sectors will be implemented. You might also say, its categories are the context factor categories of institutional performance and change, in areas where natural systems are addressed. These categories of the IoS framework are the basis for the concepts of institutional aspects and institutional compatibility used in the PICA research and adopted here.

"*Institutional compatibility refers to the compatibility between policy instruments and the respective institutional context to assess the effectiveness and efficiency of policymaking.*" (SCHLEYER ET AL. 2007a: 23). An institutional context is characterised by certain aspects, which conclusively from this perspective are called *institutional aspects*. Those institutional aspects which have been found to be decisive frequently for certain types of policies (from empirical studies or also theory based) are called *crucial institutional aspects* (CIA) (ibid.). An example for a crucial institutional aspect is the information asymmetry between government agencies on the one side and the target group on the other side. If it is either not possible, or possible only at an inappropriately high cost, to verify whether the target groups actually comply with the rules of a command-and-control policy, the policy might fail and different policy instruments may have better chances of leading to the policy goals at a lower cost, for instance giving economic incentives and organising information campaigns (ibid.).

It is important to note that although the concept of institutional compatibility can be applied to any policy area, the way it has been operationalised for PICA, it is specialised for the agri-environmental, and also applicable for other *nature-related sectors*, because they are especially characterised by interactions between the biophysical and the social world. In this context HAGEDORN (2008: 358) says: *"[…] we have to assume that the physical world (and the related physical properties of a transaction) is as important for institutional analysis as the social world (and the related characteristics of actors) and that both may substantially affect institutional change and institutional performance."*

That is why institutional aspects are not, as the name might suggest, merely aspects that are based on institutions themselves or defined by institutions like contradictory policy instruments or lobbying organisations. Instead they also comprise characteristics of nature components and particular properties of transactions relating to them, like the diffuse impact of fertilisation activities on water resources.

1.2 Main research questions and objectives

As mentioned above, this research seeks insights which may ideally contribute to refining knowledge about institutional aspects of agri-environmental policies and their ex-ante assessment. For this, a case study has been conducted. The studied policy object is the Nitrates Directive and the geographical and social focus is the region Märkisch-Oderland in Brandenburg, Germany, with the respective stakeholders located in it.

To find out about determinants and impacts of exemplary crucial institutional aspects of the implementation of the Nitrates Directive, the following questions were addressed, concerning the case study region:

Firstly, which crucial institutional aspects for the implementation of the Nitrates Directive can be identified in the case study region and how are they connected?

Secondly, which revelations does a closer, theory-guided look at the determinants of farmers' behaviour bring? In other words: why do farmers comply or do not comply with the Nitrates Directive?

Thirdly, what conclusions can be drawn from these findings for ex-ante assessment? This means, which of the insights refer to structural aspects of the region or a larger entity, and could be recognised before a policy is implemented?

These questions will be refined later on based on the explorative and theoretical frameworks (see 2.8) and the pre-study (see 4.1 and annex 2).

1.3 Structure of the thesis

In the following, the research design will be presented. This includes the organisation of the conducted research as well as the presentation of the frameworks and applied methodologies. Following this, the framework of plural rationalities will be explained in detail to show what the analysis was based on and to define terms used in the evaluation of determinants.

Next, the description of the Nitrates Directive and its overall implementation in Germany, as well as the description of the case study region shall clarify the policy and regional context of the analysis.

As introduction to the results, the overall assessment of crucial institutional aspects of the implementation in the region is presented briefly.

Subsequently, the focus on farmers' behaviour is taken, and the analysis of determinants of the same. This starts with the aspects of decision-making based on economic rationality under consideration of incomplete information, followed by social, including normative aspects, and additional rationality dynamics. This is complemented by a brief section summing up and reflecting the results in light of ex-ante assessments.

Finally, the thesis closes with conclusions.

2. Research design and methodology

2.1 Overall research framework

As explained before, in the background of the thesis stands institutional compatibility assessment of policies, based broadly on the Institutions of Sustainability (IoS) framework of HAGEDORN ET AL. (2002; see 1.1.2). Institutional aspects regarded in the analysis can be allocated in this framework. Focussing only on selected aspects, the framework can help to see those aspects in their dependence on other factors. While the analysis was initially broad, addressing all of the categories in the pre-study, it was narrowed down to looking mainly at certain aspects of the actors' characteristics, namely their utilisation of different rationalities in their decision-making. The framework of plural rationalities was itself used partially as an explorative framework to find the decision criteria of the farmers, but also as a theoretical framework to explain why certain behaviours occur. The IoS framework shows how the actors' characteristics are connected with those of transactions, and with rules and governance structures to form their decision-making.

Figure 1 shows the overall framework. It shall illustrate that the focus of this research is on those specific characteristics of the actors while still regarding the other factor categories in the given context. The plural rationalities and rationality dynamics frameworks themselves will be explained in detail later on (see section 2.8).

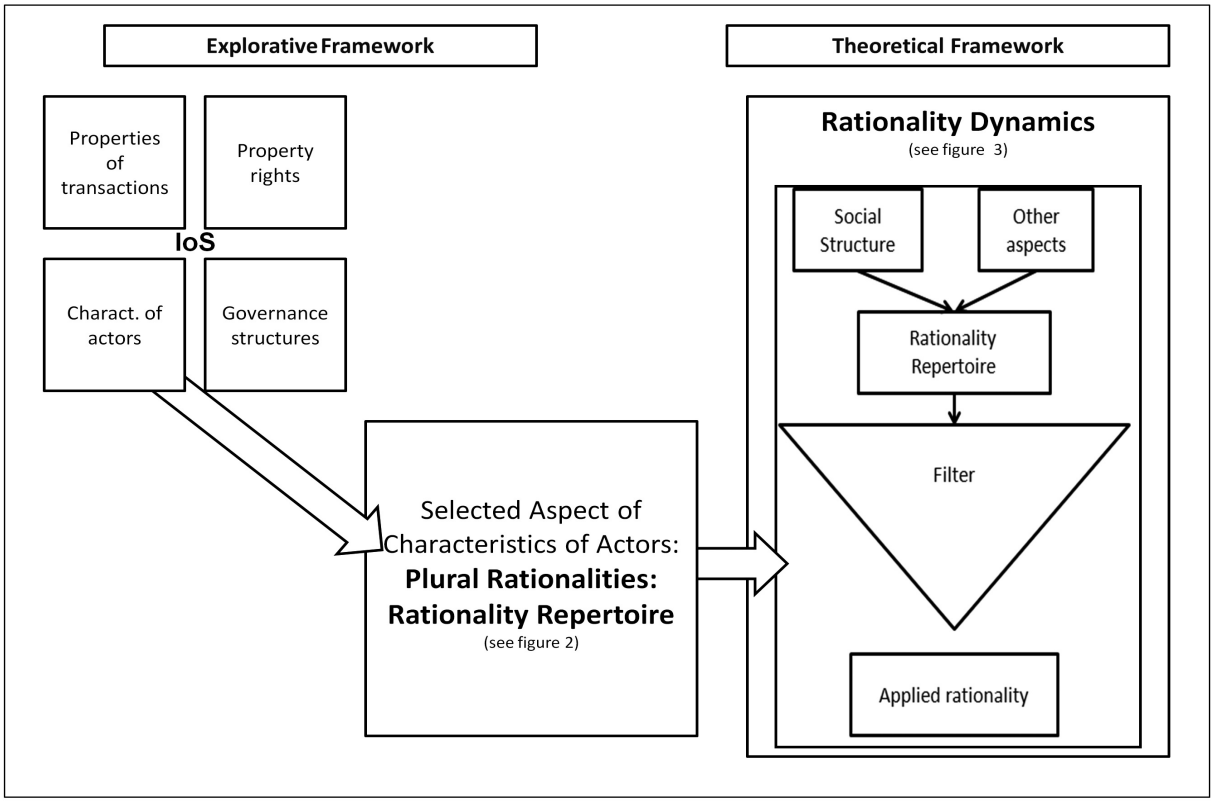

Figure 1: Overall research framework (own figure based on HAGEDORN ET AL. 2002, VATN 2005, BICCHIERI 2000, TYLER 1999, and HARLAND ET AL. 1999).

2.2 Organisation of the research

The research was organised in two research phases with distinct methodologies. The first phase was an explorative phase (pre-study), based on which refined research questions were addressed in the second phase (main study).

As an explorative pre-study, the identification of crucial institutional aspects (CIA) of the implementation of the Nitrates Directive in Märkisch-Oderland was guided by the first two PICA steps.

For the main study, instead of going from PICA step two straight to finding indicators for the respective CIA (which would be the next PICA step), research questions where refined based on the results of the pre-study and the application of a theoretical framework. This was done to find out more about the most important crucial institutional aspects of this region, namely the direct determinants of the farmers' behaviour, as opposed to other factors like, for example, regional politics and policies. The latter aspects have higher relevance in some other regions.

These two phases were embedded in background research and reflexion. Background research comprised mainly scientific literature, but also administrational and political documents, on the Nitrates Directive in general, its implementation in the EU and in the study region as well as on the study region in general, compliance with the law studies and last but not least on applicable theories.

Table 1 gives an overview of the distinct research steps and the applied methodologies. The specific methods applied will be presented and discussed in the following sections.

Research phase	**Topic**	**Methodology**
Background research	• The implementation of the Nitrates Directive in the EU and especially in Germany • Information on the study region	Study of scientific literature as well as administrational and political documents
Explorative pre-study	CIA in the study region	PICA steps one and two (with literature research and qualitative semi-structured interviews)
Theoretical background research for phase two	Compliance with the law Plural Rationalities	Literature research
Main empirical study	Determinants of farmers' compliance behaviour in the region from a perspective of plural rationalities	Semi-structured interviews
Evaluation of results from the empirical study	Interpretation of results in light of research questions	Evaluation under consideration of economic and institutional (economic) theory and complementing studies

Table 1: Research Steps

2.3 Methodology of the pre-study: PICA step one and two

In the pre-study, the first two steps of PICA, which has on the whole four steps, are applied: The first step is to classify the policy option which is to be investigated. Based on this classification, the second step begins with a first list of potential CIA drawn from the CIA library. This library is a collection of CIA which have been identified in a literature review, from theoretical considerations or previous applications of the procedure. The second step then goes on by investigating which aspects are actually crucial in the respective region. Literature reviews and empirical investigations, including interviews with stakeholders, are conducted. In the end of step two a final list of CIA has been decided on (SCHLEYER ET AL. 2007a).

If the PICA would be conducted fully, step three would be to find indicators for the evaluation of each of the final CIA (there is also an indicator library). Finally, in step four, the institutional compatibility for the region is assessed by aggregating the information about the CIA and evaluating it by grouping it into thematic categories (ibid.).

PICA in general can be seen as a procedure which facilitates the ex-ante assessment of agricultural and environmental policies by operationalising the process of the assessment and by enabling the applicant to access results of former assessments, made comparable by certain categorisations.

Applying the first two steps of PICA in this ex-post research can be seen similarly helpful. It helped to find aspects crucial to the implementation efficiently by allowing to find insights from previous literature researches and testing in a comprised way. It also structured the research of the pre-study.

This procedure also comprised conducting interviews. The interview methodology will be discussed in the next section.

A more detailed description and the documentation of the actual application of PICA step one and two can be found in annex 2.

2.4 Interview methodology in the pre-study

The extended list of CIA which had been specified for the policy case of the Nitrates Directive, mostly in Germany, was specified for the case study region, by conducting interviews. Since this was the explorative pre-study the selected interview form was semi-structured interviews with open-ended questions and a pre-planned outline of topics which ensures that certain aspects are addressed while allowing the interviewees to bring up new aspects. This allowed gaining insights which a strict questionnaire could not provide (e.g. BABBIE 2004: 245).

Since this was merely the pre-study to get some basic insights, it was judged sufficient to have interviews with one to two representatives for each of the main stakeholder groups,

i.e. *small* family farms, large agricultural companies, the agricultural government agencies and the environmental government agencies. Other interest groups were not interviewed because they did not, or do hardly, play a role in the region, especially in respect to the focus in the second phase. Certainly the significance of results is not very high with the small number of interviewees but this was only to get first insights of the situation in the region.

The interviews were structured as follows, adjusted to the respective interviewees: firstly, some background questions on the interviewee were asked. Then the specific rules were addressed, for example what they think about the rules and whether they pose problems to farmers. If certain CIAs had not come up by themselves by that time they were addressed in thematic clusters, adjusted to each interviewee. For example the clusters for the agricultural agency were *rules*, *compliance*, *monitoring* and *society*.

For the formulation of the questions quality criteria were paid attention to which are summarised by ATTESLANDER (2003: 89), especially asking as objectively as possible and not asking suggestive questions.

Also, in terms of recording and interpreting interviewees' answers, the perspective of the interviewer might influence the results, especially when interview results are captured in own words (BABBIE 2004: 263, PUNCH 2005: 58), which has to be considered.

Furthermore, there are always biases which might influence the answers of interviewees. Some biases, which might have played a role in these interviews, are: Answers may be given strategically for example, problems might be exaggerated by stakeholders to contribute to the public view in favour of the farmers or the environment Also, actors might try to put themselves, or a social group they identify themselves with, into a better light. For example, several older farmers were very eager to shed a good light on the GDR times, while others were recounting farming practices in the GDR as much less positive.

These biases will be considered in the evaluation of the interviews.

2.5 Interview methodology in the main study

In the second phase of this research, only farmers were interviewed. Even though a quantitative approach would also have been able to bring interesting results after the first qualitative phase in terms of available resources in relation to the quality of the results, the qualitative approach was more convincing for this research. On the one hand, a quantitative approach would mean that a lot more farmers would have to be interviewed to get significant results. These would have, for capacity and organisational reasons, had to be relatively short telephone interviews. On the other hand, because of the scope of the research the very small first qualitative phase left enough connections and background open to be researched in a rather open qualitative way. Additionally, for questions of

compliance it is very important to build rapport with the interviewees which is easiest when one is meeting them personally in their own office or home and having a conversation with them rather than just running quickly through a questionnaire on the phone (e.g. ATTESLANDER 2003: 179).

Despite being qualitative, the interviews of the second phase were a bit more structured than in the first. This is because this time it was not a merely explorative task anymore but an analysis of already known aspects so that more targeted questions were possible. The open questions were accompanied by some closed questions. This was less to draw real quantitative conclusions and correlations, but rather, to make the farmers' answers more comparable. Also, this technique is helpful when an interview takes too much time. Then, with the closed questions these basic questions can be answered more quickly.

Not all of the aspects shown in the analytical framework are easy to simply enquire in an interview, especially since norms are often so much internalised that the actors are not always aware of this causation of their actions. Also, since the topic has to do with rule compliance it is possible that interviewees do not want to reveal all of their actions. Finally, since it is also about a policy there might be strategic answers. This is why ideally the qualitative interviews would be accompanied firstly, by surveys allowing for quantitative correlations between actions and applications of certain rationalities and the situational cues triggering these (see 2.8.3). Secondly, experiments and observations in the field would be ideal complementations.

On the other hand, in some cases simple interview questions can bring hidden factors into the consciousness by stimulating relating thought processes (ATTESLANDER 2003: 135, 165). Also, in spite of not having a quantitative approach, i.e. being able to make quantitative correlations, some questions were addressed indirectly (or both, first indirectly and then confirmed directly) because aside from unconscious correlations, or strategic answering, interviewees may simply not know some correlations, like whether younger farmers are more aware of environmental issues because of their modern education. Indirect questions are seen ambiguously by ATTESLANDER (2003: 166) who says that it cannot generally be said whether indirect questions lead to better data because it has yet hardly been possible to prove the quality of such data. In this sense, the utilisation of indirect questions in the interviews was a trial and their results can only be seen as indications. This refers mainly to questions of said correlations, other questions could be addressed directly and have delivered better data, for example, what costs of the implementation are incurred for the farmers, or what opinion farmers have about certain environmental issues.

On the whole, qualitative interviews allowed for some interesting insights which have been enriched by comparisons with other studies in the evaluation of the interview results.

2.6 Sampling method and interviewees

The contact data for the interviews was partially received by snowball sampling and partially by using Yellow Pages and the internet. Also some assistance from the local agricultural agency is gratefully acknowledged.

The selection of interviewees was based on several criteria important for the analysis.

In the pre-study, the representative for *small* family farms was a farmer with about 120ha of arable land and a small number of pigs and poultry. This is a young agricultural *"Geselle"* who has only recently taken over the management of the farm from his father, and wants to become *"Meister"* (see glossary).

The representative of the large agricultural companies, has a university degree and manages a farm with 1860 ha of arable land and 200 dairy cows.

The agricultural government agency addressed was the regional agricultural agency, which is the agency responsible for the implementation of the regulations.

The environmental agency was one of those on the state level namely the Brandenburg State Office for Environment (Landesumweltamt (LUA)). This was done at the state level because in the pre-study not only the perspectives of the local agencies were supposed to be acknowledged and the background information was supposed to be broader. This was very helpful, even though at a later stage of the study the focus was narrowed down to only the local actors. A short enquiry by telephone with the local water agency complemented the interviews.

Again, other interest groups were purposefully not interviewed because they did not or hardly play a role in the region, especially for the focus in the second phase.

In the second phase, 17 farmers were interviewed (adding to a total of 19). The selection was based on the following criteria: Firstly, to account for different site characteristics of the region, interviewees all over the region where met, with the main difference being between the more fertile river basin Oderbruch and the poorer sites above the river level. Secondly, it was very important to ask both, farmers with a lot of animals in relation to their acreage and farmers with a small number of, or even no animals. That the animal stocks in the region are generally rather small was also reflected in the composition of the interviewees. Thirdly, it was important to ask both managers of big agricultural firms as well as those of small firms. Finally, it was important to have interviewees with different educational backgrounds.

The shares of the latter criteria again reflected the ratio in the region. This means, the region is dominated by large farms. Even the so-called small farms are more than 100 ha. A sideline farmer had 120 ha. The other small family farms which were managed by only one or two persons, had between 200 and 400 ha and small animal numbers. The large farms had around 1000 to 7000 ha. The animal stocks of cattle, pigs and poultry were in

such a ratio to the acreage in most cases, that farmers could easily spread the manure on their own fields, with some exceptions. The managers of the big farms usually had a university degree, while the smaller farmers sometimes only had completed apprenticeships but had gained neither college nor university degrees.
Some of the farmers also were local politicians and as such had a broader view on the topic.

2.7 Data analysis method

MAYRING (e.g. 2000) has developed procedures and techniques for *"qualitative content analysis"* to allow for a systematic approach using strengths of quantitative methods, but extending them for qualitative interpretation. Two of the main procedures of qualitative content analysis are the inductive category development and the deductive category application.
The analysis of the interviews in this research was widely leant on the inductive category development. This means that criteria taken into account in the analysis have firstly been derived from the theory and the literature. Taking these criteria into account in the analysis, they were adjusted to the findings; additionally new criteria which were revealed in the interviews were taken into account.

2.8 'Plural Rationalities' as explorative and theoretical framework

Since the focus of the main study is on the decision-making of the farmers concerning their compliance behaviour, a model of choice and behaviour was used as starting point to create a theoretical framework, which then also served as an explorative framework, namely the model of rational choice, more specifically of plural rationalities.
Analysing determinants of decision-making in the frame of different rationalities or logics was not just suggested to be useful by theoretical considerations, as explained in this chapter, but also by the results of the pre-study (see 4.1+4.2).
Rational choice is a concept commonly used in economics as well as in other sciences as a model of choice and behaviour. The neoclassical concept of rational choice has been proven to be in many cases too far from real situations and actual behaviour. This has first been acknowledged, by the introduction of the model of bounded rationality, among others in New Institutional Economics (e.g. FURUBOTN AND RICHTER 2000). However, many scholars of different disciplines (see 2.8.2), among others, *New Classical Institutional Economists* (e.g. VATN 2005a&b), have gone further than this and have broadened the concept of *economic* and *instrumental* rationality to one that distinguishes between *economic* or *instrumental* on the one side and *social* and/or *normative* rationality on the other side.

The concept of plural rationalities has also been applied in the research on factors of compliance with the law. The main examples, which have influenced the thesis in this respect, are the following. NIELSEN (2003) has developed a framework for analysing compliance with regulations in fisheries management where he differentiates between instrumental and normative rationalities as determinants of fishers' behaviour. TYLER (1999) has done a study on compliance with the law in Chicago where he identified different kinds of instrumental and normative rationalities that guide people's behaviour. In the Netherlands, ELFFERS ET AL. (2003) looked for factors of compliance with a law on agricultural chemicals and a tax law, with a rational choice framework applied with the *"Table-of-Eleven"*. WENZEL (2004) studied factors of tax evasion in Australia. And WINTER AND MAY (2001 and 2002) distinguish calculated, normative and social motivations, equivalent to the respective rationalities, for compliance of Danish farmers with manure storage and fertilisation rules.

To find out more about upon which rationalities actors act in which way under which circumstances can also be of interest for ex-ante assessments of policies, namely where structural factors concerning the decision making of actors can be identified and thus be used for ex-ante impact assessment or for adapting policies to these factors.

Employing a plural rationalities framework to analyse the compliance of farmers in this case study helps to find out more about the motivation of farmers to comply or not to comply, and to look for determinants of their behaviour which are structural in the region (or other entity) and might thus be recognisable before a planned implementation of a policy. Such a framework on the one hand gives hints to look at the range of possible behavioural logics (rationalities) that may be employed by the actors in the field – in this sense it serves as an explorative framework. On the other hand, it gives insight into interrelationships of factors and supports the explanation of observations, thus serving as a theoretical framework.

The different concepts of rationality and the connections between them have been synthesised to a theoretical framework, oriented much on VATN (2005a&b), and filled and complemented by work of other authors, as the basis for the subsequent research. The framework is summed up in 2, and explained in the following.

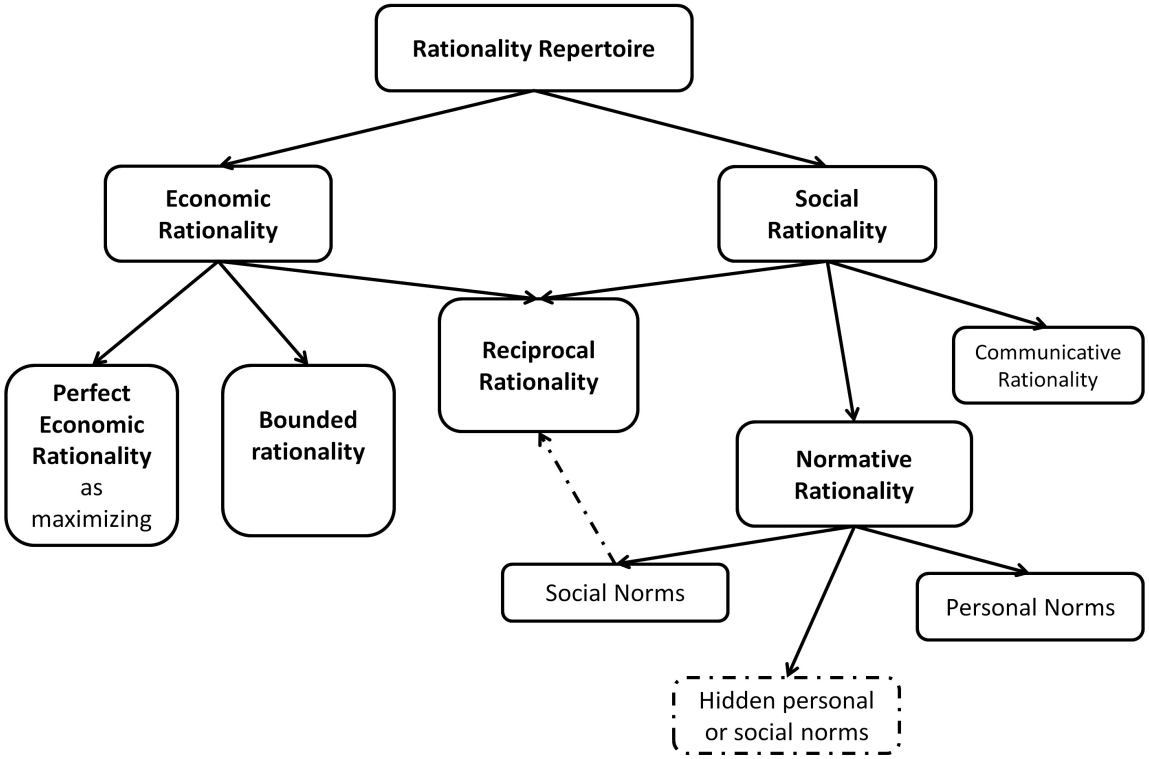

Figure 2: Framework of plural rationalities: rationality repertoire (own figure based on Vatn 2005, Bicchieri 2000, Tyler 1999, and other authors cited in the chapter).

2.8.1 Economic rationality

2.8.1.1 Perfect economic rationality as maximising

Rational choice belongs to the core assumptions of neoclassical mainstream economics and is defined as self-interested utility maximisation by individual actors with fully consistent and stable preferences. This is usually applied in models which also assume that agents *"have full information, where transaction costs are zero, all resources are individually owned and competitive markets govern resource allocations"* (EGGERTSSON in VATN 2005b: 204), and that agents take their decisions independently of the institutional context (VATN 2005).

This means that every economic action taken is based on a cost-benefit-analysis which allows the actor to see what precisely his gains from an action are and what precisely he has to pay for it; and that he subsequently will decide based on the balance of this calculation, ignoring all other aspects such as ethical ones.

This obviously is a perspective relatively far from the real world which still has its value as a simplification for certain models, yet only in narrow terms for very specific models.

Since in this research no such models are applied, the concept of perfect economic rationality is not applicable but rather bounded economic rationality or more generally instrumental rationality.

2.8.1.2 Bounded rationality and economic rationality as satisficing

As an approach to the true nature of people, the model of bounded rationality, or imperfect individual rationality was introduced, for example, in New Institutional Economics, where it is a core assumption of transaction cost economics. For this branch it is especially fundamental since acknowledging transaction costs means acknowledging that perfect information cannot always be gained or comes only with additional costs, i.e. transaction costs (FURUBOTN AND RICHTER, 2000: 3-4) and that humans do not have the capacity to process all information.

Bounded rationality still assumes individually self-interested motivations. However, because of imperfect information, certain strategies may be taken that cannot be accounted for in the perfect rationality approach. VATN (2005: 118-121) identifies making satisfactory choices instead of optimal ones as the most important strategy. This is why he differentiates economic rationality *"as maximising"* on the one hand, and *"as satisficing"* on the other hand. Satisficing means setting a target and trying to achieve it by the first best strategy, instead of looking on and on for the best solution (ibid. 118). Habits and rules of thumb are also often associated with this. They do not set targets but they are *"regularised procedures that are seen as capable of producing satisfactory results"* (ibid. 19). In terms of transaction cost economics, it means that the information costs are lowered as a trade-off to better results. This plays an important role in the nitrates problem, which will be shown in the results.

2.8.1.3 Instrumental reciprocal rationality

Instrumental reciprocity means that a person does something for somebody else because he receives some benefit from it. This obviously is the foundation of economic exchange, but has to be mentioned here explicitly, because below, one aspect of social rationality will be reciprocal rationality from a social perspective. Contrary to instrumental reciprocity, in social reciprocity, a person may act cooperatively, disregarding personal gains or losses (e.g. VATN 2005, BICCHIERI 2000). In the widest sense, every reciprocal behaviour may be seen as a social exchange for the own benefit because the idea behind it may always be to get a net benefit from being a cooperative member of the social group in the long-term. Similarly to habit and rules of thumb as a solution for bounded rationality, here too, certain behaviours that may entail consciously accepted personal losses can be seen as simplifications to the impossible task of calculating in every situation what the net benefit of the cooperative or non-cooperative behaviour will be in the long run (TYLER 1999: 170-173). However, this is such an indirect effect, functioning via social constructs like personal moral and values and happens unconsciously, so that it is for the analysis here more useful to make the distinction between economic and social reciprocity.

2.8.1.4 'Instrumental' and 'economic' rationality: terminology

In the rational choice literature often instead of the term *"economic"*, *"instrumental"* is used to describe this kind of perfect as well as bounded rationality. These terms are used both by some authors pretty much interchangeably (like VATN 2005a&b, NIELSEN 2003). But especially where not only economic approaches are taken but also philosophical ones the term *"instrumental"* is used more frequently (e.g. NIDA-RÜMELIN 2000). Actually, there even are more terms used for this, e.g. Bolan (1999) also uses the word *"technical"*, or others like WINTER AND MAY (2001) use *"calculative"* for *"instrumental"*. But *"instrumental"* and *"economic"* seem to be the most commonly used.

In the following, the term *"economic rationality"* will mainly be used because this research is about the behaviour of people in their role as economic actors.

2.8.1.5 Shortcomings of the concept of economic rationality

There are two critical points about economic rationality, identified in the literature reviewed, namely that social aspects are too seldom recognised in economic literature, and that even if recognised they are often still integrated in a too narrow cost-benefit approach.

That not only economic factors matter in the decision-making but also other factors like culture, norms, and social structure, was formerly widely disregarded in economics (e.g. BECKER AND MURPHY 2000:3). Meanwhile, however, the literature review suggests that it has been acknowledged among more economists. For example, Gary S. Becker whose deterrence model (BECKER 1968) is seen as fundamental for the economic rationality approach in compliance matters (NIELSEN 2003: 425) has meanwhile acknowledged that these other factors should also be taken into account in economic considerations. In 1968 BECKER, in his article about crime and punishment, focused on economic matters, for example, prison time valued based on lost income, and attitudes towards risk taken into account with an expected utility approach, and did not consider norms and culture in this analysis[3]. Meanwhile he has broadened this economic approach (BECKER AND MURPHY 2000), in which the second critical point is reflected: Some economists now consider norms and other factors in their economic analysis within the concept of the homo oeconomicus who is a self-interested utility maximiser (VATN 2005a: 124). BECKER AND MURPHY (2000: 5) show *"how to incorporate social forces into this approach".* In this sense, everything can be regarded in terms of utility maximisation, like regarding the

[3] Actually, this is not supposed to imply that Becker was not aware of the existence of other factors in earlier years, nor is it supposed to judge the significance of his economic analysis on crime and punishment in any way. It is just a prominent example for the economic rationality approach.

benefits of altruism as the satisfactory feelings gained from a behaviour that is consistent with one's own values.

You may argue then, that we do not need to change or extend the concept of rationality. There are, however also arguments against this. That this view may be ethically debatable, is a point which will not be discussed here. More importantly, VATN (2005a: 123-125) argues, that in fact, not all of behaviour can be explained in this sense. On the one hand, he says that often times actions will be taken based on the consideration of what seems right in that moment without thinking about consequences, like feelings of guilt, for which there is sufficient empirical evidence. On the other hand, even if the social or altruistic behaviour would be merely based on weighing potential feelings of guilt against feelings of satisfactions, this would simply be *"the effect of a social creation, of internalising the norm. The feeling of guilt is exactly a sign of that."* (ibid. 124). This is why for the analysis of the behaviour in contexts where norms and social considerations play a role, it is important to regard the social aspects of rationality explicitly as well, and not as part of self-interested utility maximisation. This is to say, that in the context of a perfect market with no physical interlinkages where prices for goods mirror their exact *real value*, individual economic rationality may apply sufficiently. However, especially in the context of environmental issues with complex interlinkages and external effects, an extended view is necessary (ibid. 125).

This view of the necessity of an extended rationality concept is adopted here as well. In this analysis, determinants of the farmers' compliance with the policy rules are supposed to be identified, and evaluated in terms of their usefulness of ex-ante assessments. Because of this, it is useful to have (relatively[4]) clear differentiations between determinants and between categories of determinants. That is, even just in terms of the selectivity of the terminology it is useful to distinguish more forms of rationality. This more selective terminology helps to identify more determinants and links between them than just the cost-benefit approach, since precisely the distinction between solely self-interested behaviour and behaviour based on social considerations has to be analysed.

[4] 'Relatively' because it is not always possible to make absolute differentiations between factor categories.

2.8.2 Social rationality

A rationality concept entailing social and normative logics as drivers of behaviour besides economic ones, has been used in many disciplines[5] besides economics.

Actually, even though rationality has mostly been conceptualised as instrumental in economics, for example in sociology, Max Weber already had acknowledged the social side of rational choices in the early 20th century (BOLAN 1999).

One early economic article on this topic is SEN's "Rational Fools" (1977). He argues that the role of rationality differs in different application areas, and that economic considerations entail their specific aspects. Within economic contexts, he finds that the meaning of social and normative factors in rational choice plays, among others, especially a role in questions of public goods. Here, deciding against free-riding has to do with cultural determinants like moral, attitudes and especially commitment.

While for a comprehensive approach of understanding rational choice it is important to integrate many disciplines, in a specific study a specific focus has to be taken. And here, since this research is about persons acting as economic actors in a market situation and their behaviour towards, and in dependence of, specific institutions, the focus will be an institutional economic one.

While in New Institutional Economics the concept of economic rationality as maximising utility and the concept of bounded rationality play fundamental roles (FURUBOTN AND RICHTER 2000), the broader concept is more used in the (new) classical institutional economics, where generally *"behaviour is dominantly understood as socially created, implying that choices reflect norms, rules, and expectations built into the institutions of a society"* (VATN 2005b: 206).

Sometimes the variety of rationalities is considered rather implicitly. For example, HAGEDORN ET AL. 2002 emphasise, concerning the actors' characteristics in the Institutions of Sustainability framework, the necessity to look at actors beyond self-interest guided individuals and at the influence of values, beliefs, attitudes and behavioural norms.

The term *"social rationality"* (and equivalently *"cooperative rationality"*) is used by VATN in contrast to economic rationality. Within this category he distinguishes *"normative"* and *"reciprocal"* rationality and additionally mentions *"communicative"* rationality according to Habermas (VATN 2005a: 123-125). As opposed to VATN, most of the authors referred to in

[5] Even though, lines between disciplines are not always strict within the social sciences, representatives are for example, for philosophy e.g. NIDA-RÜMELIN 2000 and BICCHIERI 2000, for sociology VOSS 2000, for political science ZINTL 2000, for criminology ELFFERS ET AL. 2003 and in the wider sense, for psychology, HARLAND ET AL. 1999 (based on what disciplines they are professors in and/or in what kind of journal the example was published).

this thesis like BICCHIERI (2000), directly subdivide rationality into *"instrumental/economic"* and *"normative"* rationality but mean pretty much the same.

Finally, *"social rationality"* as adopted in this research, can be defined best in contrast to instrumental rationality: while the latter one means that choices are based on the pure self-interest, social rationality implies choices based on the consideration of aspects of social belonging, of everything we consider not just because we have in mind what is best for ourselves as individuals but what is best for ourselves as members of social complexes, which is reflected in norms and moral reasoning.

2.8.2.1 Reciprocal rationality in between economic and social rationality

In VATN's terms *"the distinct feature of reciprocal rationality is a propensity to respond positively to sympathetic actions and negatively to unfriendly behaviour, despite individual losses in, for example material rewards from such a response."* (VATN 2005a: 122).

BICCHIERI (2000) and VATN (2005a&b) give overviews on some game-theoretic experimental evidence and empirical evidence from the field for this kind of rationality. The ultimatum game is a prominent example where people may and do partially reject money if they feel the offered sum is unfair, rather than keeping at least the small sum – they prefer to punish the unfair sharer who does not get anything either when their offer is rejected (e.g. BICCHIERI 2000: 174). An example for environmental behaviour is that an important motive for recycling was that interviewees wanted other people to recycle and said if they expect it from others, they have to do it themselves as well (VATN 2005a: 399).

For VATN the difference between reciprocal and normative rationality is the following: Firstly, reciprocal behaviour can sometimes be explained with social norms which tell to cooperate – but since norms for social rationality are not always about cooperation, it would at least be an independent subcategory of normative rationality. Secondly, reciprocal behaviour is not necessarily based on a norm in the narrow sense, but sometimes more on a general convention such as *"It is just the way things are done."* (ibid. 123).

Still, other authors acknowledge the reciprocal dimension of social rationality as well but under the category of social norms. For example, BICCHIERI (2000) also finds reciprocal aspects, although she subsumes it under normative rationality.

Additionally, important aspects of normative rationality found by TYLER (1999) belong to this category. Although his categorisations are different from VATN's, he explicitly discusses the social exchange character of the normative rationality aspects he identified (ibid. 170-173).

The rationality aspects identified by TYLER are especially interesting here, because they directly refer to compliance with the law as *"the everyday behaviour of citizens toward the*

law"[6] (ibid. 3). The empirical basis for this was a study including surveys with citizens of Chicago, which is referred to as *the Chicago study* (e.g. 172). While this is not perfectly comparable to compliance with fertilisation rules, these could still hint at some aspects of compliance with the Nitrates Directive.

TYLER's (1999) most important aspects, which can be viewed as reciprocal are *legitimacy* and *procedural justice.* In the Chicago study, procedural justice was the *"key normative judgement influencing the impact of experience on legitimacy."* (ibid.162). He also identifies *distributional justice* as a determinant of perceived legitimacy, but it plays only a minor role in the Chicago study.

It has to be noted, that there is also an economic (or instrumental) perspective on procedural and distributional justice. But those concern the size of the benefits of the outcome and are not about the fairness of the outcome, while the majority of the interviewees in the Chicago study found the fairness of the procedures more important than the outcome (ibid. 165).

Legitimacy was recognised as a key to feeling obliged to comply with rules in the Chicago study. This is often measured as support, but support leads to compliance only via obligation (ibid. 28). In general there are three levels of main objects of legitimacy: The authorities, the regime, and the community (ibid. 29). Authorities are for example judges, police and elected representatives. If they are perceived as legitimate, they themselves as well as their actions and policies are supported. The regime refers to *"the offices and institutions that officials occupy and [to] the procedural rules that guide their conduct"*, it can also be seen as *"the 'diffuse' support for the system"* (ibid. 29). The community refers to the social groups within it and how they are viewed. If people from their own social group (for example ethnic or religious heritage) represent authorities they may more likely be supported than "strangers" (ibid. 29).

In the study here, it is most important how people consider legitimacy of the local authorities, as well as legitimacy of the policies and of the processes of policy-making (regime). The community aspect was not explicitly addressed in the interviews, because stakeholders in the region are relatively homogeneous: most of them are white German males with no visible differences in religious or other cultural heritages, other than having grown up in eastern or western Germany (this last aspect was actually addressed in general).

[6] „The Chicago study focuses on six laws chosen to represent the range of laws people deal with in their everyday lives. […] The forms of behavior they prohibit are as follows: making enough noise to disturb neighbors, littering, driving a car while intoxicated, driving faster than fifty-five miles an hour, taking inexpensive items from stores without paying, and parking illegally." (TYLER 1999: 40).

Another aspect of reciprocal rationality, is *reputation*, and along with it a *"social motivation [which] comes from the desire of the regulated to earn the approval and respect of significant people with whom they interact"* (WINTER AND MAY 2001: 678), besides some more instrumental functions of reputation.

As said before, some reciprocal aspects can also be defined in an instrumental way. In the interviews, for some reciprocal aspects it was explored whether farmers found it reciprocal in an economic or more normative way.

2.8.2.2 Normative rationality

For consistency reasons, this category will be opened with VATN (2005a) again: normative rationality is about norms as *"response[s] to questions concerning what is right or appropriate behavior."* (ibid. 6), it is based *"on a wider set of values, such as those defining various virtues".* In contrast to reciprocity it *"is more about whom we should be as social beings than just how to act in cooperative settings"* (VATN 2005a: 123).

The terminology is not always the same among different authors, but definitions are adopted in this thesis, so as to integrate the different notions of normative rationality in the reviewed literature into a consistent framework for the purpose of this research.

For example, some authors also define social norms as *moral standards* (e.g. WENZEL 2004: 551) or use the term morale in the sense of norms as used in the concept of normative rationality (TYLER 1999: 25), while others see moral norms as a category opposed to social norms (e.g. BICCHIERI 2000). Another example is, that VATN (2005a: 6-7) on the one hand differentiates conventions and norms, so that conventions are neutral coordination regularities, while norms have to do with values that are supported. BICCHIERI (2000) on the other hand, differentiates further between descriptive norms, conventions and injunctive norms.

What can be seen as the crucial points in this literature for the purpose of this research is the differentiation between social norms and personal or internalised norms and between norms which are conscious or which are hidden, respectively adhered to unconsciously.

Social norms are such norms, which are *"attributed to a social group or collective"* (WENZEL 2004: 151). They are norms which are in the consciousness of the social group and the group expects the individuals to adhere to these norms. The crucial thing here is that people may obey the norms without attributing any value to them themselves (BICCHIERI 2000: 159). This form of a norm has to be supported by social control and punishment (VATN 2005a: 123).

In contrast to this, a *personal norm* is an *internalised social norm*, which is adhered to independently of whether other people can observe the own behaviour, and react to it or not, because one is convinced of its value (VATN 2005a: 123; BICCHIERI 2000: 159). In

terms of obligation, internalised norms are differentiated from obligation towards external actors, like authorities, in that the obligation is towards one's own opinion of what is morally right (TYLER 1999: 25).

This differentiation can be operationalised for a survey by asking questions about social norms in the form of *"what do most people think?"*, or *"what do other people expect one to do?"*, and asking about what the interviewee thinks himself or what she feels obligated to, for personal norms (WENZEL 2004: 556 and HARLAND ET AL. 1999: 2513, respectively).

Social norms are more likely to be connected to reciprocity since it is about expectation of other people and their reaction, which makes it, in a way, an exchange of acts – but since the border between reciprocal and normative rationality is overlapping anyway, it seemed appropriate to introduce this one in this category, because of its close connections to personal norms.

As can be supposed intuitively, personal, internalised norms have been found to be more important than not-internalised social norms for compliance behaviour in cases with high information asymmetry, that is where aberrant behaviour is not easily detected (e.g. WENZEL 2004).

The second differentiation between norms, named above, is whether norms are consciously adhered to or unconsciously (e.g. BICCHIERI 2000, VATN 2005a). When acting, people do not always consciously think about why they act in a specific way. Just as behavioural norms can be used as simplifications towards constantly making new decisions, the norms can, possibly for further simplification of the process, be applied automatically, without even being aware of it. Afterwards, if an explanation is asked for, a rational explanation will be looked for, which may be fully independent of the initial reason which led to the behaviour (BICCHIERI 2000: 162-163). This obviously is a problem for field research as utilised in this thesis, because unconscious norms cannot easily be detected. This problem was discussed in the methodology part.

An interesting example for people acting upon other norms than those conscious to them is an experiment done in the US in the 1930s, when there were strong prejudices against Chinese. The researcher went with a Chinese couple to 251 hotels, motels and restaurants, where they were always served without any problems with one exception. Six months after this, a postal survey was done with the establishments visited before. It turned out that more than 90 % of the respondents actually claimed that they would not accept *"people of Chinese race"* in their establishment (LAPIERE 1934 IN BICCHIERI 2000: 160). Thus, some socially friendly norms were actually adhered to rather than the conscious norms on how to treat Chinese people.

2.8.2.3 Communicative rationality

Based on Habermas, VATN (2005a: 125) introduces communicative rationality as an additional kind of rationality. Communicative rationality implies, that a rational decision on a behaviour, which is accepted by a certain circle of persons, or furthermore a behavioural norm itself, can be reached through argumentation. Under the condition that participants of the argumentation speak truthfully, do not exert power on one another, and do not have hidden intentions, an argumentative discourse can lead to rational outcomes. Since this applies more to collective action in general, and in the context of the Nitrates Directive to the political processes of shaping the rules, it is only a marginal issue here, mainly represented as the meaning of communication between farmers for the adoption of farming practices and compliances with the fertilisation rules.

2.8.2.4 Irrationality

To complete the picture, following VATN (2005a), it shall also be mentioned what irrationality is in contrast to those rationality categories. It can be seen as irrational to have inconsistent preferences or to do something other than one wants to do (in the boundaries of what is possible at a reasonable effort). It has to be acknowledged, though, that preferences can seem inconsistent from an economic rational perspective while making sense from a social perspective. Additionally, it can be irrational to prefer something, which cannot be explained by argument. The latter one only accounts for social rationality, since for individual preferences no account must be given. However, just as people often act without being aware of the norm that they are adhering to, they can also adhere to a norm, which they, or the social group the norm is attributed to, do not remember the reason for because they trust that the norm has good reason. This is part of the information problem, because gaining information is costly. Similarly, an action based on false assumptions of cause-effect relationships cannot be called irrational because from the person's point of view there was a reason (ibid. 132-134).

2.8.3 The rationality repertoire in actual situations – dynamics of rationalities

Up to now, a concept of plural rationalities has been presented. Consequently, it has to be asked next, how these rationalities are applied in actual situations. Based on BICCHIERI (2000), VATN (2005a), HARLAND ET AL. (1999), and TYLER (1999) the model shown in figure 3 is adopted.

After those authors, it can be said that for every person there are several possibilities which rationality to apply in a given situation. I will call this the *rationality repertoire*. Surely, everybody has the possibility to act according to any of the rationalities.

However, the probability of each rationality to be applied in a given situation, and the specific way in which it is applied, is individually different. It depends on the one hand on the social *structure, including the institutional context,* in which a person's repertoire has been shaped, and on the other hand on *personal aspects* like the individual's learning capacity or family background.

BICCHIERI (2000: e.g. 158) and HARLAND ET AL. (1999: 2508) for example, talk about the fact that which norms and conventions are internalised by people, and thus the openness towards instrumental and social rationalities, among others also depends on the culture and social context in which they grow up (e.g. p. 158). VATN (2005a: 156-158) says, that whether somebody acts in a specific situation in a self-regarding *"'I'-manner*", or in a social *"'We'-manner*", depends, among others, on how the personality of a person is shaped.

In actual decision cases, upon which rationality of this repertoire will be acted depends on the specific situation, the context and the personal preferences. These act like a *filter* of the repertoire, so that finally one rationality will be – consciously or unconsciously – chosen and applied. BICCHIERI (2000) talks about *situational cues* that determine which rationality, and in case of a social rationality, which norms are applied. HARLAND ET AL. (1999: 2524) talk about *"activation"* of norms in specific situations concerning environmental behaviour.

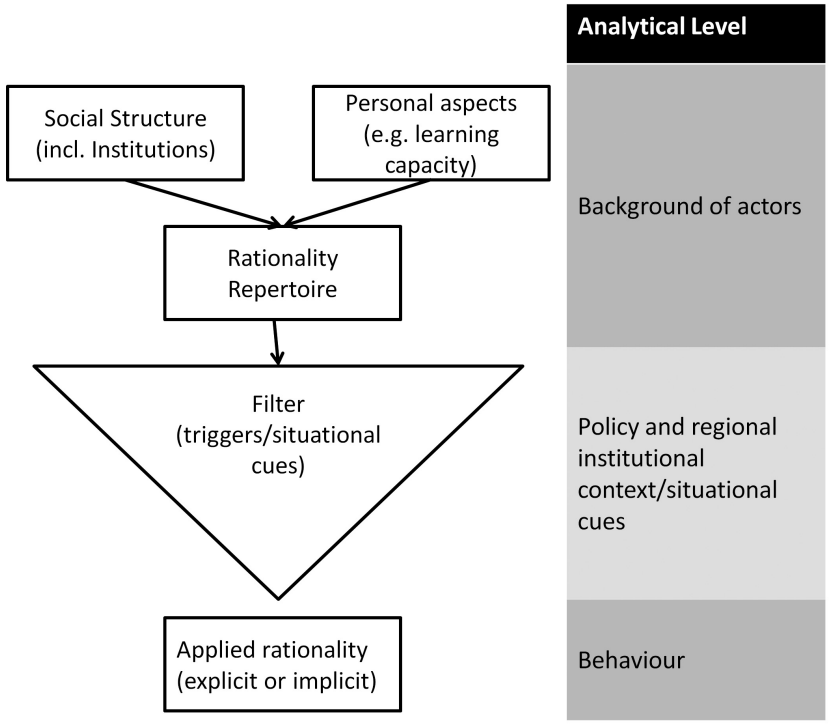

Figure 3: Framework of rationality dynamics (own figure based mainly on VATN 2005, 2008 BICCHIERI 2000, TYLER 1999, and HARLAND ET AL. 1999).

VATN (2005a: mostly 126-132; 393-402) very much emphasises the relevance of the institutional context as part of (what I call) the *filter*. According to VATN (2005a: 156), a typical type of behaviour showing the connection between institutional context and applied rationality is that of decreasing supply of a good when payments for the same are introduced. For example, it has been observed that when a payment for blood donation is introduced as an incentive to donate, the amount of blood donated actually decreased (ibid. 156). This implies that the logic of the situation was changed from that of a normative to an economic perspective (ibid. 156). This was a trigger, or situational cue, for people to act upon economic rationality – and in terms of economic rationality, they would not sell their time and blood for the offered amount.

VATN also offers more insights on compliances with environmental policy rules: Evidence from different studies suggests that compliance is not always correlated to control as the neoclassical assumptions imply. In the latter view, the higher the control and punishment is the higher compliance will be. In reality, it seems rather that this is only the case when norms supporting the demanded behaviour have not been internalised by the actors, that is, if they act based on an economic rationality, i.e. an analysis of their expected private costs and benefits. If however, they are already making decisions based on a social rationality, then the introduction of control and punishment can lower compliance to a certain point. This change of the policy incentive structure, like in the blood donation example, triggers the actors to think in economic terms and calculate how much non-compliance they can afford (ibid. 395-396). The best incentive structure in cases where social norms are internalised would thus be to have only a small amount of control, yet a relatively intense punishment. This way, if somebody gets caught cheating, the positive self-image of those who had internalised the norm already, gets enforced (ibid. 397). For this policy strategy it is important to find the fine line between too much and too little control. After all, if nobody ever gets caught, it would become too easy to cheat, at least for those individuals who have not internalised the social norms.

This, by the way, applies to firms as well as to private persons, even though in general, a stronger focus on revenue maximisation can naturally be found in firms (ibid. 400).

Where social rationality can potentially be used, economic and advisory policy respectively non-deterrent measures may be more effective and more cost-efficient than command-and-control policies (e.g. WINTER AND MAY 2001).

2.8.4 Applying the rationality framework to this study

To sum up this chapter: Generally, from this framework of plural rationalities, questions arise which could provide answers that may be very helpful for an ex-ante assessment: Firstly, how are the rationality repertoires of the actors in the region shaped and which

rationality is triggered by the policy? If there is a strong normative rationality basis, a command-and-control policy might be inappropriate for the target group or vice versa. Secondly, how would the rationalities be applied in the specific case? That means for example, if economic rationality is applied, do the determinants lead to compliance or to non-compliance? This includes how actors deal with bounded rationality, i.e. incomplete information.

These questions have been found crucial for the implementation of the Nitrates Directive in Märkisch-Oderland during the pre-study (see 4.1+4.2).

What an ex-post case study can do in this respect is to initially look at which rationalities have been applied to which consequences in the region, and then to look for determinants of this. These determinants can then be evaluated in terms of their usefulness for ex-ante assessments by looking at which of them are structural in the region (or to another entity) and would be accessible to such an assessment.

Therefore, in this research the different aspects of rationalities and selected institutional *filter components,* or *triggers*, were adjusted to the policy case of the Nitrates Directive, and addressed in the interviews. Analytical levels were a) behaviour of the farmers in dependence of b) the background of the actors (e.g., education, age), and c) the policy and regional institutional context and situational cues (e.g., procedural fairness). This application will be presented in section 4.2 where the results of the research will be revealed and discussed.

3. The case study elements

In the following some general information about the Nitrates Directive and its implementation in Germany will be presented. The purpose of this is to give context information to the case study, and also to explain how the direction of the case study was chosen. Subsequently the specification of the case study policy measure is presented, and last but not least the case study region.

3.1 The Nitrates Directive

The Nitrates Directive (ND) is a policy measure of the Council of the European Communities which was adopted in 1991 due to rising endangerment of water pollution with nitrates from livestock husbandry and excessive fertilising in agriculture. The directive's objective is to *"[reduce] water pollution caused or induced by nitrates from agricultural sources and preventing further such pollution."* (Art. 1).

This directive obliges the member states to take certain measures which have to be introduced with some latitude, mostly via national legislation. The main requirements are the following:

1. Detection of polluted or threatened waters (Art. 3, 1) (e.g. if there is more than 50 mg/l nitrate in the groundwater or could be if no action is taken)
2. Designation of vulnerable zones (Art. 3,2) (called NVZ for *Nitrate Vulnerable Zones*)
3. National, voluntary codes of Good Agricultural Practice (GAP), complemented if necessary by a *"programme, including the provision of training and information for farmers, promoting the application of the code(s) of good agricultural practice"* (Art.4)
4. Action Programs within vulnerable zones (Art. 5):
    a. GAP Codes become mandatory plus other measures, specified in the directive, if not yet comprised in the GAP
    b. Additional measures have to be taken if aims cannot be met otherwise
5. National monitoring of water quality to assess the effectiveness of the measures (Art. 5 and 6)
6. Assessment and revision of policy measures every four years (Art. 5)
7. Revision of vulnerable zone designation every four years (Art. 6)

Instead of designating individual vulnerable zones the member states also can make use of Art. 3,5: *"Member States shall be exempt from the obligation to identify specific vulnerable zones, if they establish and apply action programmes referred to in Article 5 in accordance with this Directive throughout their national territory."*

In this research the rules under investigation are the requirements concerning farming practices. The requirements on monitoring of the water quality will not be dealt with since they concern a different action arena with different actors, transactions, and partly institutions and governance structures. To be brief, in the following the term *implementation of the Nitrates Directive* will be used mainly in respect to the farming aspects.

3.1.1 The implementation levels of the Nitrates Directive in Germany

For the development and implementation of a policy several generalised phases that are passed can be identified as parts of the policy cycle, for example: "*Agenda setting, policy formation, decision-making, policy implementation, and policy evaluation (resulting in the decision to continue, modify, or terminate the policy)"* (SCHLEYER ET AL. 2007a: 95).

If we look at the policy implementation in the narrower sense it can be regarded between decision-making and policy evaluation. That means, it has been decided already how, and with what specific measures the policy is to be implemented. However, in the case of an EU Directive it is a bit more complex.

When the first three steps of the policy cycle have been completed, the policy has to be implemented in the member states. This involves a restricted form of policy formation and decision-making again since the directive has to be transferred into national law with some scope of its realisation, so that some policy formation is still involved. Even agenda-setting may still play a role because in certain cases it is crucial whether the requirements of a directive are just met in the narrowest sense or whether it receives more attention in the political debate.

In the case of a federal state like Germany this process can gain another round: the federal government can leave some (or all) duties of implementation to the federal states where similar processes have to take place.

Finally, the practical implementation of the policy measure takes place on the regional and local level where, in case of the Nitrates Directive, farmers actually have to change their practices and local administrations are confronted with the implementation as well.

For the Nitrates Directive, Germany made use of the option to designate the whole state territory as vulnerable zone. This is why a major share of the directive's requirements have been fulfilled on the national level. However, some points were left open to be specified and implemented by the German states.

3.1.1.1 National level

The most important measure through which the Nitrates Directive was implemented in Germany is the Düngeverordnung[7] (DüV), the by-law on fertilisation. While the DüV is not limited to nitrogen fertilisation, most of the Nitrate Directive's requirements concerning agriculture have been transferred via this by-law as well. An exemption are the rules for manure storage which are regulated in the Anlagenverordnung[8] (VAwS), the by-law on storage of substances which are hazardous to waters.

[7] The full title is: „Verordnung über die Anwendung von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln nach den Grundsätzen der guten fachlichen Praxis beim Düngen".

[8] The full title is: „Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen und über Fachbetriebe"

In the DüV, the codes of Good Agricultural Practice (GAP) concerning fertilisation, including the mandatory regulations from the Nitrates Directive, have been described and are mandatory for all farmers in Germany. In contrast to this, accompanying measures like education, extension work and investment support, e.g. financial aid for storage of livestock manure, are the responsibility of the German states (BMU 2004: 28-33).
Aside from the mandatory fertilisation GAP in the DüV, there are also overall GAP that include, among others, some measures conducive for the aims of the Nitrates Directive. Those GAP are not mandatory. Although they have been introduced on the level of the federal states, they are based on a national resolution by the national and state agricultural ministers and thus can be counted to the national level. (ibid. 28)

3.1.1.2 State level ('Bundesländer')

The most crucial requirements have been met on the national level while the measures taken on the level of federal states have been the *soft measures*. The term *soft measures* in this case refers to those measures not being command-and-control measures but rather information and financial support measures.
To say that those are not the most crucial requirements of the Nitrates Directive is not a judgement but refers to the fact that they are not absolutely mandatory for the member states to implement but often introduced with the term: *where necessary* – which is often a question of perspective.
Measures taken by the federal states have not necessarily been taken specifically for the implementation of the Nitrates Directive. For example, whereas in Brandenburg, one measure taken are the recommendations for fertilisation and other information brochures (MLUR 2000, MLUV 2007, LVLF 2008b), many agri-environmental policies like the Kulturlandschaftsprogramm mainly aim at a general extensification of agricultural practices (EWERS AND HENRICHSMEYER 2000: 63).
Reversely, not all measures taken against pollution of waters with nitrates can be attributed to the Nitrates Directive. For example KASTENS AND NEWIG (2007) as well as KERSEBAUM ET AL. (2006) are writing about the reduction of nitrate leaching from agricultural sources, not based on the Nitrates Directive but on the Water Framework Directive.
In the German report on the implementation of the Nitrates Directive the naming of the German states' measures is rather vague (BMU 2004: 36 et sqq.).

3.1.1.3 Local and regional level

Concerning the fertiliser rules from Nitrates Directive the local level is the level where they actually have to be applied by the farmers. Besides the farmers, on the local, respectively regional level the agricultural and environmental agencies are crucial for the implementation since they are the executing agencies, do most of the monitoring, i.e. stand in a principal-agent relationship with the farmers, and are their main administrational contacts. Aside from those actors, it is also possible that interest groups like environmental groups or the water industry play a role on the local level. They could be involved in accompanying measures or become active by themselves by demanding actions from farmers, or getting into contact with them in respect to giving information, starting communication or developing cooperative agreements.

3.1.2 Overall implementation in Germany

Even when the DüV was finally adopted in 1996, five years after the passage of the Nitrates Directive, some requirements of the Nitrates Directive were not met and only after interference of the European Court of Justice the DüV was finally revised and the new versions adopted in January 2006 and again in January 2007.

Already before the Nitrates Directive was adopted in 1991 by the Council of the European Communities, the nitrates problem was debated, in German politics and beyond. For example, with the Drinking Water Directive, the European Council already had introduced the upper limit of 50 mg nitrate/l for water intended for human consumption (80/778/EEC).

The phase of agenda-setting in case of nitrates from agricultural sources was characterised (at least in Germany) by the focus on health aspects in drinking water, from the scientific perspective, whereas CONRAD (1992: 72) emphasises that nitrates in vegetables could also have been made an issue, as well as the environmental perspective which played a minor role in the beginning. So, instead of taking a broader approach, the drinking water industry became the major stakeholder as opponent to the farmers. (CONRAD 1992: 72, 78). After the initial phase, the topic became the forerunner of the agri-environmental policy debate, which it ceased to be when later agri-environmental policy became broader in the nineties.

The most crucial constraints of the early national implementation of a nitrates policy can be found in the lobbying power of the agricultural sector as well as in the interplay between the agricultural and environmental administrations, information asymmetry and the capacity of administrations.

Just as the farmers and drinking water industry were opponents, so were, in a way, the environmental and agricultural administrations. At least to some degree the agricultural

agencies tried more to represent farmers' interests while the water agencies were more active for water protection (ibid. 76-78).

Also the aspect of information asymmetry was a problem from the beginning of nitrates policies. The entry of nitrates into the water through entrance of nitrogen fertilisers into the soils is a diffuse non-point pollution which is not easy to control. Lacking capacities of administrations to conduct controls intensifies this problem (ibid. 71-87).

Crucial constraints in the recent nitrates policy and Nitrates Directive implementation are still very similar. Information asymmetry, lacking administrational capacities and controls, and partly the interplay between the agricultural and environmental administrations, are seen as crucial aspects along with others (see annex 2).

On the national level, a crucial aspect still seems to be the lobbying power of agricultural interest groups. In fact, even when the adjustments to the actual requirements were finally made under pressure of the European Court of Justice in 2006 and 2007, there was another political debate on the degree of the implementation. The farmers' lobby wanted the realisation of the EU's demands to meet only the judicially necessary requirements, while environmental and water sector representatives generally demand stricter measures for the protection of waters against nitrates.

For example, the BUND (2007) claims that nitrates are still the most important groundwater problem in all of Europe, that agriculture is the most important pollutant, and that nationwide more has to be done. They say on the one hand, that in the respective laws and by-laws like the DüV there are too many poorly defined terms and possibilities for exemptions for farmers, and that the GAP have to be more groundwater friendly. On the other hand, while some regulations may already be useful in theory, they claim that control of the implementation is much too weak.

Similarly, HAAKH (2006), speaking from the perspective of the water industry, firstly finds that the regulations of the DüV, among other regulations, are insufficient to reach satisfactory water qualities. Secondly, he too emphasises that, besides the deficiencies of the rules, there are big problems in their execution as well.

The agricultural lobby oppositely demanded that regulations become no stricter than necessary, especially in view to economic competition with farmers from other European countries (DBV 2005, LAND UND FORSTEN 2005, HEUTE IM BUNDESTAG 2004). This refers mainly to size of fertilisation distances to surface waters, allowed N surpluses in fertilisation, level of upper limits of livestock manure fertilisation, the valuation of N availability in livestock manure, and the intensity of regulation in general (LAND UND FORSTEN 2005).

Even though there are strong contrasts between the different lobby groups, it has to be added that some of the farmers' demands do not necessarily contradict those demands of

more effective measurements. For example, one demand was not to lower the limit of the absolute amount of livestock manure applied to the soil, another demand was not to apply the regulations uniformly on the whole state territory. The first demand is in line with the argument that, what is decisive for the nitrates pollution in the waters, is the N surplus and the resulting N leaching. This way, absolute limits seem not to be that effective. The second demand at least is in line with the argument that measures have to be adjusted better to regional characteristics and farming reality. This however does certainly not mean that general mandatory codes of good agricultural practice for all farmers would prove useless.

Now, to judge whether the influence of the agricultural lobby was actually very strong in the recent implementation is not an aim here – although it should be noted that even some farmers in the conducted interviews said that they were astonished that the DüV had become rather milder than stricter, with some exceptions.

Having shown the political debate, some scientific arguments on the German nitrates policy shall be mentioned as well. Scientific literature actually suggests that the implementation of the Nitrates Directive and the general nitrates policy in Germany is not sufficient to meet satisfactory targets (e.g. KASTENS AND NEWIG 2007: 234; KERSEBAUM ET AL. 2006: 352,: BROUWER ET AL. 2003: 68). The situation is summed up by KERSEBAUM ET AL. (2006: 352): *"In Germany, about 30 % of the observations within the national groundwater-observation network showed elevated nitrate concentrations (>25 mg NO3 L–1 or >5.6 mg N L–1), mostly located in areas with dominantly agricultural land use (UBA, 2004). For Germany, agriculture was estimated to contribute 62 % of non-point-source pollution of surface waters (UBA, 2004). Nitrogen surplus has increased during the last decades and remains after a short phase of decline at a high level (e.g., BACH and FREDE, 2001; NIEDER ET AL., 2003), although different regulations and tools were developed to reduce excessive N applications on agricultural fields."* However, it has to be acknowledged, that very different and partially very long retention times and movement of the water in the ground, lead to the fact that sources of nitrates in the groundwater often cannot be identified accurately (BMU 2004: 24; LUA EXPERTS 2008). That means firstly, in some areas agricultural practices may have been groundwater friendly for many years but a change in the water quality cannot be seen yet. And secondly it means that especially in deeper groundwater levels it is not always possible to say for certain whether a pollution stems primarily from agriculture or whether it comes from other sources like household sewage or industries. Still, it is evident that agriculture plays a crucial role (BMU 2004, LUA 2007).

Even though a judgment of the policy realisation is not the topic of this research, the viewed literature hints to nitrates policies not being accurate enough – be it because of

being spatially too broad and not sufficiently region and site specific, because of too few cooperative and participatory approaches, or even because of too little constraints for agricultural practices.

Finally, it should be added that for the current German nitrates policy the WFD (Water Framework Directive), which goes beyond the Nitrates Directive, is sometimes used as the crucial link (KASTENS AND NEWIG 2007, KERSEBAUM ET AL. 2006). For the state environmental agencies the WFD especially plays a role in respect to cooperation between agricultural and environmental agencies and increased possibilities for measures that go beyond command-control-policies (LUA EXPERTS 2008). Still, in terms of agricultural practices the Nitrates Directive and respective parts of the DüV are still important points of reference which is also reflected in its role in cross compliance and, not least, the daily practices of farmers.

3.1.3 Specification of case study policy measure and level

In the focus of this research are the fertilisation and storage rules, i.e. the regulative aspects of the Nitrates Directive, for the farmers. There are three reasons why the regulatory aspects of the Nitrates Directive will be the focus of investigation in this case study: Firstly, the regulatory elements represent the core of the Directive. Secondly, due to its incompleteness in the DüV, this part of the directive has partially been implemented only in 2006 and 2007, which leads to the issue certainly being more present in some stakeholders' perceptions, so that the interviews may be more fruitful in terms of drawing conclusions for ex-ante assessment. Additionally, as explained before, it would be difficult to assess which soft measures have been taken concretely as a measure for the Nitrates Directive's implementation. Nonetheless, the soft measures will not be ignored but regarded as independent variables that may or may not have an influence on the implementation as accompanying measures.

The implementation of the regulative measures of the Nitrates Directive can mainly be regarded on two levels: The first one is the transfer into German law on the national level. The second one, is the level of local and regional implementation. The focus of this research is on the latter one.

The concrete rules that farmers have to adhere to, can be summed up like this:

- Mandatory fertilisation planning and balancing (each year)
- Frequent livestock manure and soil analysis
- Limits of N surpluses to minimise leaching
- Absolute limits to the application of N from livestock manure (170 kg N/ha on crop land)
- Restrictions on the timing: closed periods where no fertiliser may be applied (1. Nov – 31. Jan); limited fertiliser application after the last harvest before the winter (40 kg Ammonium or 80 kg accumulated N/ha after last harvest, before the winter)
- Limitations of applications under circumstances when and where uptake is low or losses probable (e.g. wet soil or steep slopes, near water bodies)
- Minimum storage capacities for livestock manure (e.g. slurry for 6 months)
- Burden of proof: farmers have to keep records that prove their fertilisation balances.

More details will be explained along the analysis.

3.2 Case study region

3.2.1 Administration

The case study region is Märkisch-Oderland. The region is bordering Berlin in the north-east and is part of the German state of Brandenburg. It consists of two sub-regions: one is the Oderbruch, which is the flat ameliorated basin of the river Oder. The other one, including parts of the Barnim is slightly hilly, and lies above the river basin.
Märkisch-Oderland is the administrational unit of this area (in the GDR there were more units) which is the relevant unit for this institutional analysis because it is the level of the executive agricultural and environmental government agencies.

3.2.2 Farm structure

In 2007 there were 547 agricultural companies with an average of 231.6 ha in the region. However, 97 % of the farms have an average of 466.3 ha, ranging from 50 to several thousand ha. Almost a quarter (21 %) have 1000 and more ha with the average being 1852.6 ha (MOL 2008). This means the farm structure is characterised by large companies. For comparison, Brandenburg‘s average is 198.1 ha (ibid.), Germany’s average is 48.9 ha (BMELV 2007), Bavaria’s average is 27.3 ha (StMLF 2008:30), and the EU-25 average is 15.8 ha (VAN ITTERSUM 2009).

Most of the production is cereals (55 %). Other products are pulses (2.4 %) and root crops (2.1 %), fodder plants (15 %), *"Handelsgewächse"* (oil fruits, seeds, tobacco, spices and others) (16 %), fallow land (8 %) and a few vegetables, strawberries, and garden plants (1 %) (MOL 2008).

There is a high rate of arable farms and only little animal production; although a few large animal production facilities exist, including pigs, poultry, cattle and dairy production. The important characteristic to note here is that livestock manure resulting from animal production is less than could be used if it was spread out on the fields of the region, similarly as in whole Brandenburg where the live stock is less than 0.4 animal units per ha (LVLF 2007: 55).

In contrast to the rest of the region, the Oderbruch with better production capacities has been managed more intensely than the rest of the region, after its amelioration in the mid 18th century, which allows limited comparisons for different site soil characteristics.

3.2.3 Natural production capacities (soils and climate)

Märkisch-Oderland is one of the driest regions in Germany with a semi-arid climate with average precipitation of 470 mm/year, a potential evaporation of 640 mm/year, and an actual evaporation of 430 mm/year (MÜLLER: w.y.).

The soils are fairly heterogeneous but generally rather poor and dry. They belong to the sand covered ground moraines (*"uebersandete Grundmoraenen"*) and usually have a relatively high share of sand, especially in the surface layers with loam layers beneath. Characteristic is the brownearth-albeluvisol (*"Braunerde-Fahlerde"*). These are often times marginal production sites with *"Ackerzahlen"* (the German arable land index)[9] from 28-44 (MLUV AND NATURSCHUTZFOND 2005). In the Oderbruch, soils are generally a bit better. There are more loamy and clay soils (the characteristic soil is the *"Auengley"*), which is good in terms of water and nutrient holding capacity but connected to problems with wetness in spring and dryness in summer. This is why it is suboptimal for grassland and horticulture, so that arable fields dominate the surface. Also, the high heterogeneity of soils with sand lenses (*"Sandlinsen"*) is disadvantageous (MÜLLER: w.y., MLUV AND NATURSCHUTZFOND 2005). However as said before, the production capacity is generally better in the Oderbruch. The average Ackerzahl is 47 with big ranges between 25 and 80. And indeed higher yields than in the rest of the region are normal (according to farm interviewees), which accounts for 94 % of the surface being arable land (MÜLLER: w.y., MLUV AND NATURSCHUTZFOND 2005).

[9] 'Ackerzahlen' in Germany are a measure of the quality of a soil at a specific site for crop production or grassland in terms of their production potential, taking into account mainly soil type, relief and climate. It is based on comparison, with the best soils having the value 100 (BAHRS AND RUHR: w.y.).

3.2.4 Water quality

Altogether, Brandenburg has only few problems with nitrates. However, in Märkisch-Oderland there are *hotspots* with relatively high concentrations of nitrates and ammonium. In spite of being intensely used for agriculture, the Oderbruch has hardly any problems with nitrates but instead with ammonium. This is part of the same problem as nitrate, only in the case of the Oderbruch and other regions of Brandenburg, nitrogen is being transformed into ammonium rather than nitrate because of the soil structure (LUA 2007: 83-85). The maps show the hotspots of nitrate and ammonium in the region with the purple colour being the highest values and blue the lowest. It has to be noted that the colour purple is already allocated to values of slightly above 25 mg/l whereas the upper limit for nitrates is 50 mg/l. Even with this in consideration, two control points surpassed this upper limit, one in the north and one in the middle of MOL (LUA 2007: 66). Also, the ammonium values are more critical than the nitrate values in MOL and generally in Brandenburg. Low nitrates values veil the problem of nitrogen entry into the groundwater. Ammonium values in the Oderbruch reach more than 1 mg/l (purple), whereas the threshold for it in the Drinking Water Directive is 0.5 mg/l (98/93/EC). However, at least for humans ammonium is not as toxic as nitrate.

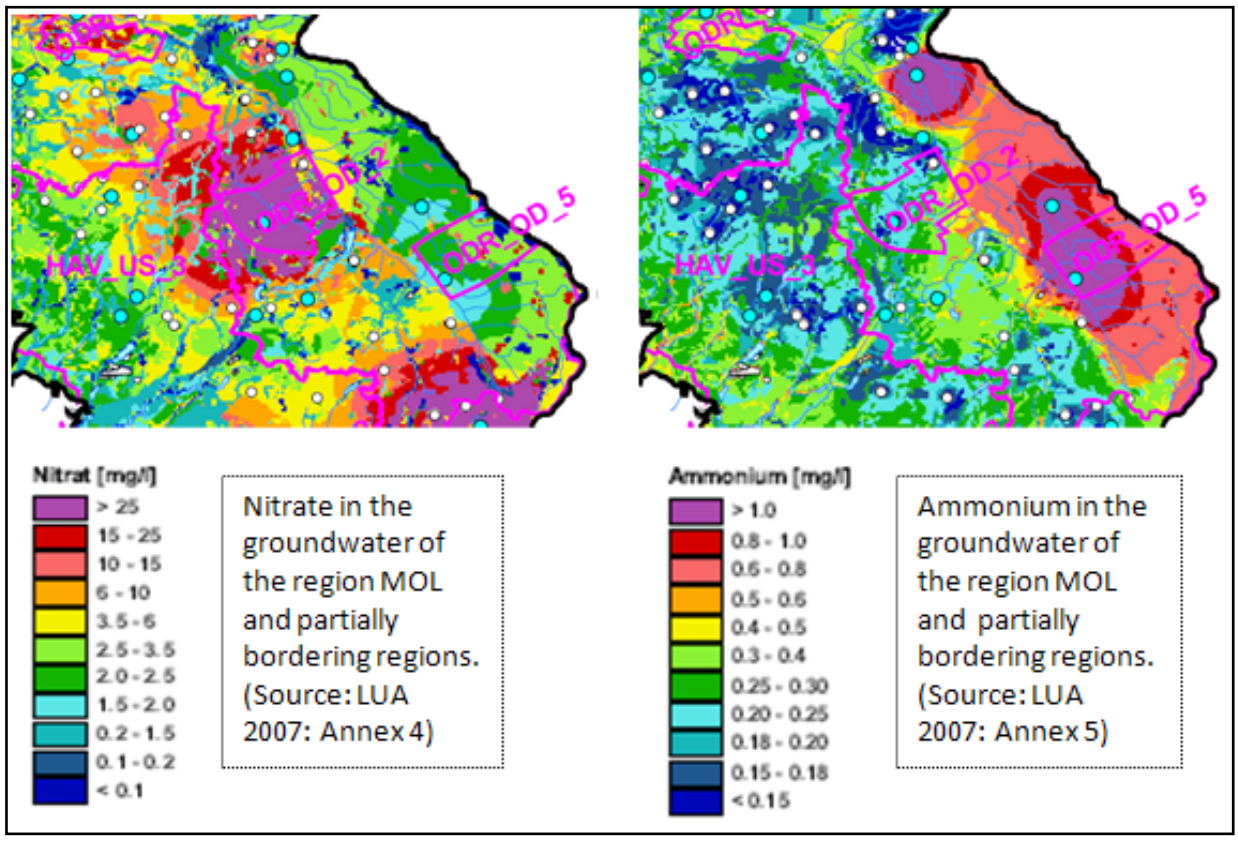

Figure 4: Nitrate and ammonium in the groundwater of Märkisch-Oderland (LUA 2007).

This again does not necessarily mean that current agricultural practices were responsible for the high values. As the experts of the LUA explained in the interview, from a value of 10 mg/l nitrate in the water, it is certainly an anthropogenic pollution and agriculture undoubtedly plays a major role in it. However, it is hard to reconstruct the time and place of the initial entry of the nitrogen (LUA EXPERTS 2008). Locally the sources are hard to spot because of the movement of the groundwater. Chronologically a reconstruction of events is often not easy because percolation through the soil can take 1-100 years and rather longer in soils of the region, because although being often sandy there are hardly any fissures.

3.2.5 Compliance with the Nitrates Directive and fertilisation practices

To say how good compliance with the nitrogen fertilisation rules in Märkisch-Oderland is, is not easy. Some evidence suggests, though, that it is rather good.

On the level of the state Brandenburg estimated numbers exist for the nitrogen balances per ha for all the arable fields, based on some representative farms. The average surpluses of the last 6 years (2002-2007) are 41 kg N/ha, ranging between 25 kg and 68 kg each year (LVLF 2008a:48-49). This is not only in the range of what is demanded from 2009 on in the DüV on the average of 3 years (60 kg N/ha), and way below the German averages (which have since the 1960s always been over 70 kg N/ha, for a long time even over 100 kg N/ha and in recent years between 80 and 100 kg N/ha (BACH in HAAKH 2006: 147). It is also close to what Haakh (ibid.), demands as a representative of the water industry, which is 40 kg N/ha as the maximum. And it is also within the range of what Eckert et al. (2000) have identified as sustainable surpluses: They say that 20 kg N/ha surplus is necessary to keep soil fertility because of natural losses. For other non-controllable factors they add 10 kg N, and under certain rainwater condition 20 kg N more. So in sum 30 to 50 kg N/ha are the optimal surpluses from this perspective.

Interestingly, for P there is even a negative balance of 4 kg P/ha/year in 2002-2007 in MOL (LVLF 2008a: 49), which reflects that farmers try to minimise fertiliser costs.

A small restriction to these statements is that these numbers are only based on certain reference farms and not on a central registration of all farm balances.

Also, part of MOL, namely the Oderbruch, is one of he most intensely used regions with a large amount of ammonium in the groundwater and above the threshold nitrate values in the Oderbruch's north and west of it.

However, the overall situation will probably still be relatively good as the following evidence suggests as well.

The effectiveness of controls of compliance is very restricted, but they do still allow for a broad picture of compliance in the region according to the interviewee of the agricultural agency. This interviewee also explained that there are only few trespasses:

The *upper limit* of 170 kg N/ha from livestock manure is hardly ever exceeded.

For *storage capacities,* mostly there seem to be no problems, and this is supposedly relatively easy to control. However in the interviews of the main studies this did turn up to be a problem for some companies which might not lead to massive pollution but should not be underestimated.

The compliance concerning *field middens* was really a problem until recently when the timeframe to store livestock manure as field middens was prolonged from a quarter towards half a year for litter manure (this is not specified in the DüV but by the MLUV for Brandenburg). It cannot be judged here, whether this prolongation is in itself contravening the targets of the Nitrates Directive or whether this is really just a sensible solution. There were different opinions among the farmers themselves but mainly they commented that if the stockpile is done right and it actually contains a certain amount of litter, i.e. is relatively dry, then there will be very little more losses in the additional three months.

From time to time it happens that somebody violates the closed periods. Those closed periods were heavily debated by few interviewees but most said that they pose no problem.

Fertiliser planning and balancing and *soil analysis* is good with the large agricultural companies but sometimes is lacking with small companies and part-time farmers. This raises the question, how it can be known whether the applied amount of fertiliser is in an appropriate range or not.

Numbers of the cross compliance controls give a different picture. In 2005 in one of 2 controls a violation was revealed, in 2006 in 10 of 15 and in 2007 in 4 of 8 (these were only the CC controls for the Nitrates Directive, excluding the DüV controls). These devastating results are relativised by the fact that most of these were only minor violations. The dominating type of violation was the missing of fertiliser balances. This can especially be seen as a minor problem if there is still enough evidence for the controller that there was no inappropriate excess fertilisation. Also the representative of the agricultural agency identified a positive trend with farmers being more aware of these issues in 2007 than in 2006 and in 2008 than in 2007 (MOL EXPERT 2008).

For comparison, the violations revealed in controls in all of Germany during 2002 were in 12.6 % of the controls lacking soil analysis, 6.8 % ignorance of absorptivity of the soil, 6.5 % fertilisation in the closed period, 4.6 %, missing proof of fertiliser balances and fertiliser planning, 3.6 % not keeping the records for the required period, 3.8 % no immediate working in of the fertiliser, 2.09 % missing N analysis of livestock manure, 2.5 % not

avoiding direct entries and preventing run-off of fertilisers into water bodies, 1.3 % too much N from livestock manure, and 0.75 % too much N from slurry, liquid manure and other liquid fertiliser (*"N-haltigen flüssigen Sekundärrohstoffdünger"*) (adapted from BMU 2004: 33-34). This shows that here too the most violations are in respect to planning, calculation and record keeping, and hardly in excess fertilisation.
However, for both, the Brandenburg and all-Germany case, it has to be added that these numbers do not show whether in the cases of missing planning, calculation and record keeping it was possible to exclude the possibility of excess fertilisation. Also in a regular control what is being controlled is the records, not the actual farming practices. The latter ones can usually only be detected if a citizen reports conspicuities to an agency.

So, summing this information up, it can be assumed that compliance with the nitrogen fertilisation rules in the region Märkisch-Oderland is currently relatively good, but there still are some violations of the rules observed and some questions open. Also, in terms of fertiliser balancing and record keeping the rules are only recently, that is since the introduction of cross compliance, getting complied with more frequently.
This way, mainly the region can be regarded as best practice case study with conducive institutional aspects to find. And at the same time some constraints can be investigated too, for the present situation or from the past.

4. Results

4.1 Crucial aspects of the implementation of the Nitrates Directive in Märkisch-Oderland

In the pre-study a broad assessment of aspects which are crucial for the implementation of rules based on the Nitrates Directive in the region Märkisch-Oderland was done. It was conducted following the first two steps of the PICA. This means, based on the classification of the policy, some CIA were chosen as potentially relevant in the concrete case. This was complemented by a literature review, and four expert interviews (see 2.). The description of this part of the research process and the intermediate results can be found in the annex 2.

Here, the final results of the pre-study, complemented by information gained in the main study, on the overall picture of crucial aspects in the region, will be presented.

These are displayed in figure 5.

In the background of the regional aspects are the determinants of the national level where most of the transformation of the Nitrates Directive into German law was done.

As one can see, there are two main strains of determinants of the implementation of the Nitrates Directive in the region Märkisch-Oderland.

The CIA of the first strain add up to the *incentives which farmers have to comply with the law*. The main categories of determinants are here *perceived costs and benefits*, which are strongly influenced by the *complexity of the water-soil systems* which make transactions insecure but also account for the *information asymmetry* between the state and the farmers. The latter is important through the sanctions which farmers have to face if their non-compliance is discovered. However part of farmers' behaviour could be seen as irrational when looking at it from an economic perspective. Other factors can be subsumed under the categories of *internal norms* and *social incentives*[10]. When farmers follow drivers which are socially rational but not economical, they face trade-offs which can be crucial for the implementation of a policy. Also, there are aspects which are seen as economically rational by some farmers and irrational by others – because of this the term *perceived costs and benefits* was chosen.

[10] Internal norms which lead to actions for the environment can also be seen as social incentives which is indicated in the figure by a connection between both.

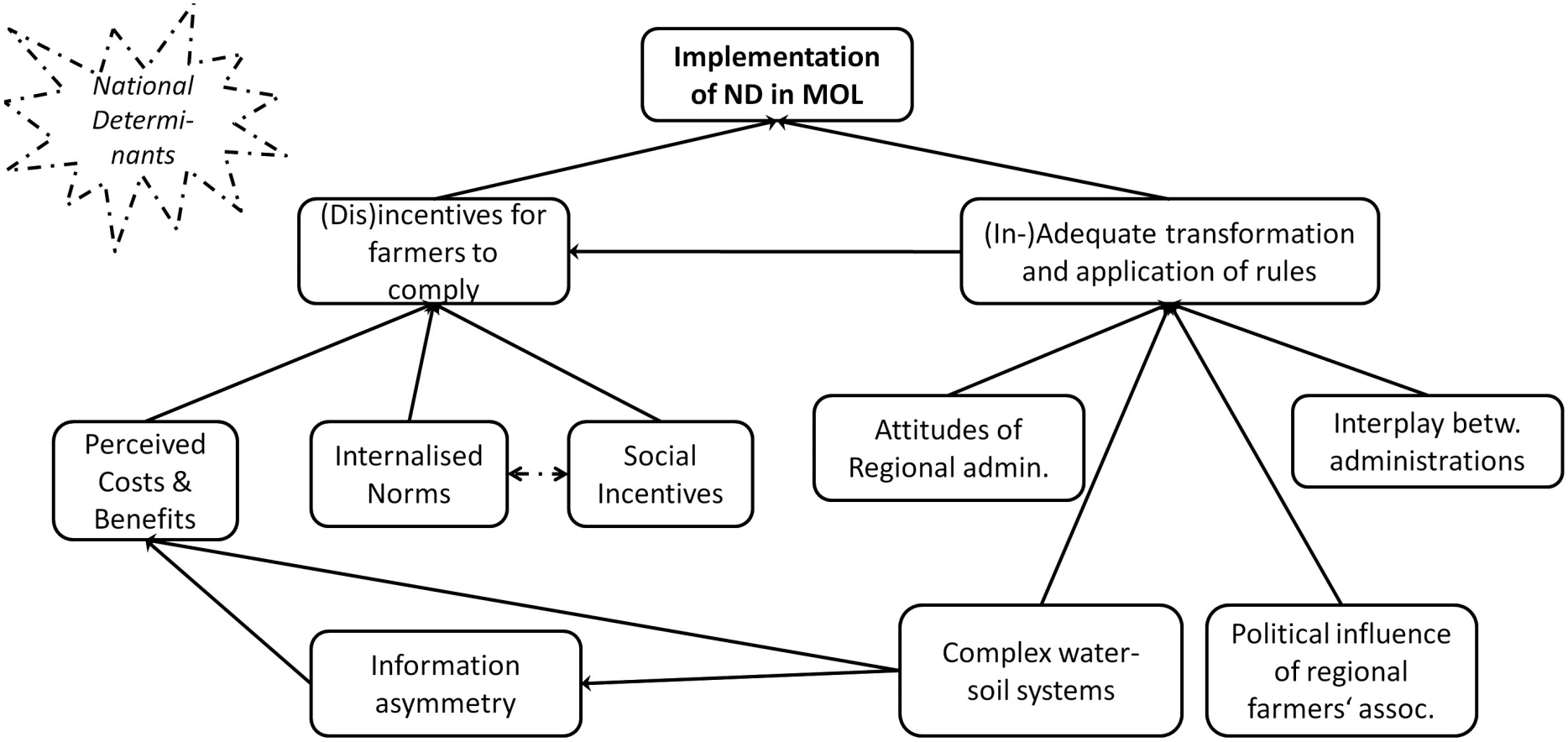

Figure 5: Summary of crucial institutional aspects of the implementation of the Nitrates Directive in the region Märkisch-Oderland (own figure).

The second most important strain of CIA was the *transformation and application of rules* in the region, and whether these ended in an adequate implementation of the Nitrates Directive. As the regulative measures of the Nitrates Directive were mostly transferred in the DüV and the storage requirements in the VAwS, there were not so many decisions left to take on regional and state level. An important specification of the rules are the requirements for field middens. The time restrictions for those have only recently been loosened significantly in favour of the farmers on the level of the state Brandenburg. It cannot be judged here what impact this has on the environment but it does suggest a certain, not necessarily negative, influence of the regions' *farmers associations*.

Farmers associations, more precisely a political party of farmers in the regional parliament (*"Kreistag"*), have also influenced the filling of posts in the regional agricultural agency in the past, and thus the *attitudes represented in regional administration*, as an interviewee explained. This may explain the very good relationship between agency and farmers which could be an indicator for indulgent enforcement of the rules on part of the agency. Actually, it was not recognisable whether this had any negative impact on the Nitrates Directive implementation. On the contrary, a positive influence by this on the farmers' decision-making could be identified, which is explained in the main analysis (see 4.2.2).

In this respect it is also important that the interplay between the agricultural and the environmental administrations is good, because the different perspectives on agri-environmental issues could thus be discussed and balanced. It seemed that on the regional level this interplay was working well. At least neither interviewees from the agricultural nor from the environmental agency had any complaints about the other. This was however investigated very superficially as part of the short pre-study and was not part of the focus of the research. On the state level, which is also crucial for the region because most decisions on rules are made there, and important information is gathered and distributed there, it was a bit different. Representatives of the environmental state agency said that they had only very little insight into the work of the agricultural agency, and also into their knowledge of the behaviour of the farmers. Especially, in regard to nitrate they thought that access to centrally registered data on N fertilisation and soil nutrients would be useful for their work. Also, better communication would be seen as useful, but was already improving at the time of the interview (spring 2008) in the context of the implementation of the WFD.

The work of the administrations and political decision-makers regarding development of and decisions on measures against nitrates in the waters is also very much influenced by the *complexity of the water-soil systems* concerning the formation and distribution of nitrates in the waters, because it is usually very difficult to find out from where and from what time a pollution stems.

Those two strains are naturally not strictly separated because many factors of the *transformation and application of rules* have a direct influence on *farmers' incentives*. From a legal point of view, the first one has an own role in making the legal and state executive aspects meet the requirements of the directive. Looking at it from the environmental perspective, though, it only has an impact via influencing farming activities. Yet, some of that influence is very indirect.

With the high importance of farmers' behaviour, the analysis of the determinants of the farmers' decision-making was chosen as the focus of the main study. While in the end, this is connected to all other aspects in one way or another, only those aspects directly influencing the farmers were analysed. For example, the interplay of the administrations was not analysed further at all, and the attitudes of the staff of the agricultural agency were only looked at indirectly in terms of influence of the relationship between the farmers and the agency.

4.2 Specific aspects of farmers' compliance with Nitrates Directive rules

As explained before, the focus of the main study was on factors determining farmers' compliance with the rules stemming from the Nitrates Directive. The main study was guided by a framework of plural rationalities to distinguish not just the different determinants but also the different logics applied in farmers' decision-making, especially when economic and social considerations suggest different kinds of behaviour, or when certain issues can be seen as economically rational from one perspective but irrational from another.

In fact, a large part of compliance with the Nitrates Directive in the case study region can be explained with economic determinants. However, there are still several issues where compliance would be economically irrational but it seems that farmers still comply. Also, in contrast to the past there are some issues which have been seen as too costly in the past but nowadays are either seen as economically rational or self-evident for normative reasons. Similarly, there are also issues which farmers in some other regions do not comply with because they find them too costly, whereas many MOL-farmers consider them economically rational. This way, it is interesting to look for determinants of these different kinds of decision-making under conditions of incomplete information.

The presentation of the results will start with the economic aspects, and will go on with the social and normative aspects, complemented by some additional considerations of rationality dynamics and concluding with reflections on the relevance of the results for ex-ante assessments.

4.2.1 Bounded economic rationality determinants

The presentation of aspects of economic rationality will be organised in the way of a cost-benefit analysis (CBA) since this is the basis for economically rational decision-making. Costs are therefore divided in costs for non-compliance (sanctions), additional production and opportunity costs, transaction costs, and direct benefits for the farmers.

The costs and benefits are described in a qualitative way. That means, it matters what the costs and benefits consist of in the light of economic theory and what this means to the farmers, their producing, and consequently their decision-making. At the same time, a quantitative assessment of concrete costs would not support the analysis of determinants of farmers' behaviour, except for few examples.

The analysis was led by the following questions: What kind of costs and benefits occur for the farmers? What are the aspects determining those costs and benefits and the perception of those? What determines how farmers deal with those costs and benefits in case of incomplete information?

In the analysis, additional production and opportunity costs are seen as occurring when actions have to be taken that either raise the costs of production directly or when actions have to be taken that preclude other actions, respectively. Transaction costs are those not directly involved in the production process but in transferring goods and services across a technological separable interface (Williamson in Furubotn and Richter 2000: 47) and in alienating and acquiring rights of future ownership of physical things (Commons in Furubotn and Richter 2000: 48).

Naturally, any cost can be regarded in term of possibilities foregone, i.e. opportunity costs.

After analysing determinants related to sanctions, determinants for additional production, opportunity and transaction costs will at first be explained for the rules for mineral fertiliser limits and planning. On the one hand, this involves special determinants in respect to bounded rationality for fertiliser planning. On the other hand, with this example a lot of the overall determinants can be explained at length. Afterwards the other costs are explained, and their determinants only explained as necessary as complementation.

4.2.1.1 Indirect benefits of compliance: avoidance of sanctions

If farmers are caught not complying with the Nitrates Directive, they will be faced with sanctions. In the sense of a cost-benefit analysis of the compliance, these would be indirect benefits, i.e. the avoided costs.

As is economically expectable, farmers of the region emphasised that in cases where compliance is costly, the compliance does, among others, depend on those negative financial incentives.

There are three main aspects to be considered for these costs. The first is the height of sanctions. It is also important how farmers take potential sanctions into account. If farmers perceived that the probability of getting caught is low, the risk of higher sanctions may be taken more easily than if the probability of getting caught seems high. This became obvious in the interviews as different interviewees had different assumptions on the information asymmetry. Therefore not only the actual information asymmetry between the agency and the farmers has to be regarded but also the perception of the probability of getting caught.

4.2.1.1.1 Height of sanctions

For each violation of the rules which account directly for the Nitrates Directive, farmers will lose between 1 % and 5 % of their direct payments from the EU under cross compliance (CC). Additionally, for violating a regulation from the DüV, a fine between 50 and 5000 € can be demanded.

The rule that sanctions depend on the height of direct payments has only been fully introduced along with cross compliance, starting in January 2005. This rule means that larger companies have to pay higher fines. Since in this region farms are rather large (see 3.2.2) potential sanctions are accordingly high. For example, a few companies in the region received around one million € of direct payments in 2005, with the largest recipient having 2.1 million € (MLUV: w. y.). Even though the largest recipients of the direct payments are only few, they do manage a large part of the region's land. In the whole federal state Brandenburg the largest 16 % of recipients manage 77 % of the acreage and hold at least 83 % of the cattle (WOIDKE 2008).

For a large company with, for example, 700,000 € premiums, a small fine of 1 % already means a cost of 7000 €. Even for a farm with only 70,000 €, 700 € would still be the lowest possible fine for just one small violation.

Almost all farmers in the interviews said that they perceived the potential sanctions under cross compliance as serious, and much more serious than before cross compliance. This is, though, not only because of the quality of fines but also because of the application. After all, some farmers also said that before cross compliance was introduced less controls were conducted.

Taking into account that farmers may give some strategic answers, it has to be added that the view on the relevance of the sanctioning regime is shared by the representative of the agricultural agency, based on the fact that since CC was introduced, knowledge of and compliance with some rules on fertiliser planning and balancing has significantly improved.

But even if these fines were considered rather low, the rule system is so complex, that several interviewees said that with all the possibilities of losing direct payments because of sanctions, they could not afford to be inattentive concerning compliance with rules because several *small* fines in their cases easily add up to high costs. Because of this, the managers of the two largest farms visited said that they just try to do everything right to not have several small violations in the end. However, this naturally accounts especially for easily identifiable issues. For example, one farmer said, they had put buffer zones between fields and water bodies, even where it is not demanded *"to set his mind at ease" ("zur eigenen Nervenberuhigung")*. This manager frankly explained, that this way, there was no danger that any staff member would violate rules concerning spreading of manure or pesticides near water bodies, but also that the inspectors would have a good impression of the whole farm and thus be more kind or even less attentive when looking at the rest of the farm. This naturally, is not just an example of how serious the sanctions are for farmers, and how they take them into account in their economic decisions, but also for how at least some farmers calculate strictly and take the environment selectively into account for economic, not normative reasons.

The complexity of rules, though, does not necessarily lead to this kind of behaviour but has in other regions led to more socially rational actions, which is discussed in 4.2.2.2.2.

It still has to be added that in the case of manure storage, the fines are economically not high enough to deter from non-compliance, with a probable exception for the biggest farms. Investments in storage facilities are usually very costly. Depending on the duration expected to pass until offenses are found by the agency, it would be more cost efficient for farmers to not improve storage facilities.

4.2.1.1.2 Actual information asymmetry

As explained before, the first important aspect of information asymmetry are the characteristics of the resources and transactions which make it difficult to identify pollutants.

Furthermore, the capacities of the executive agencies determine how much of farmers' behaviour becomes evident through monitoring of their behaviour. This does on the one hand regard the number of controls, and on the other hand the effectiveness of controls.

For the number of controls it can be said that each year 5 % of the farms, i.e. around 25, are systematically controlled on the basis of the DüV. Further, if a trespassing is found incidentally on any occasion by inspectors or third persons who report it to an agency, it will be investigated as well ("cross-checked"). Additionally four to six farms each year are controlled directly on the basis of the Nitrates Directive.

The interviewee from the agricultural agency said that this was certainly not a perfect amount of controls and that it would always be good to be able to do more; but that this practice still allows to get a good picture of what is going on over the years and which farmers are more likely to comply or to trespass.

One aspect of the effectiveness of controls is which farms are controlled. For this, the agricultural state agency (Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung Brandenburg – LVLF) conducts risk analyses and sends the list of farms to be visited to the regional agencies, so effectiveness depends on the quality of risk analysis.

Even if controls are conducted, their usefulness depends on how well the agents are able to reveal the actual farm practices. Thus, besides numbers of controls and choice of farms the depth of controls and competency of personnel matters, too. There were different opinions on the effectiveness of controls among all interviewees.

For some of the major points, the controls are supposed to be quite reliable: What can really be controlled effectively is the proof of whether soils and manure analyses have been made if there is a letter from the laboratory.

Also, it is fairly obvious if documentation on fertiliser planning is missing. Several farmers and the agricultural government agent said that controls where effective not only in seeing whether the planning had been done but also whether the manure limits were kept. However, some other farmers said that this was not, in fact, true. One aspect is that, as some managers of the bigger farms said, it was really easy to manipulate the numbers in the fertiliser balances. They said that in a normal control the inspectors really just look at whether the fertiliser balance is mathematically correct and the evidence like manure sales contracts are fitting. They said that mostly the inspectors did not have much time and many times even were not agricultural experts and thus could only perform the control based on their given schemata. This means that without much effort, it would be possible to change some numbers in the balances and hide documents on the purchase of fertiliser. This kind of fraud would only turn up in a deep investigation.

Most farmers think that in the case of a really deep and thorough investigation, most violations would turn up, however they assume that this kind of control is not done because it is not feasible.

Also, when soil analyses are one basis for the fertiliser balance, a manager said, several soil or manure tests of the same unit deliver very different values. Of these values he would just use the results suitable for his balance. However, it was not clear, whether any of the interviewees actually used such a method at all, except for a minor violation, not least because one would have to pay several separate analyses. Besides, as the government agent said, the agents have an idea of how the yields, N losses and N in

livestock manure in this area in the respective year can be expected to be. The LVLF develop reference values on the basis of data from reference farms and experiments. So bigger deviations from the reference values should call the attention of the inspector – if he is sufficiently trained, which is not always the case according to the interviewees. In other words, cheating may be possible, if a company is being controlled, but for most issues only small deviations from the rules are secure, while bigger deviations should call the attention of most inspectors.

There are other parts of the rules of the Nitrates Directive which are less effectively controllable.

An aspect of the storage capacities for manure, some farmers said, is that if there are not enough manure capacities, they could create a false supply agreement with someone. With a false contract another farmer would have to take the risk that he would get caught cheating. It seems that this is seen as very unlikely since controls are rather superficial. Whether this is actually being practised by farmers is not clear. Finding takers for manure is rather easy in the region, but on the other hand farmers wish to use the manure themselves, as it is considered to be good and more or less cheap fertiliser.

Yet, some interviewees faced storage problems which would cost them a lot of money if they built all of the needed storage facilities. One legal way out was to use field middens, which was formerly allowed only for 3 months. This was a problem for several farmers as the agricultural government agent said. Two interviewees claimed that they, where needed, moved the field middens from one spot to another – which is very costly as well, and not really serving the purpose of the regulation. If this cheating is done properly, it must involve a change in the documentation, too. One of those interviewees admitted upon request that big cheats would probably be conspicuous, but that with the large acreage and many fields he had the possibility to push numbers around to some useful degree. However, the state regulation about field middens was recently changed from 3 months to 6 months which was good enough for almost all of the interviewees.

It is even easier to cheat concerning the application rules for fertiliser. This refers to taking distance to water bodies, including ditches, not to apply fertiliser to too wet or frozen soil and similar issues. These rules cannot be monitored by the inspectors. At the most, they can be attentive when passing by fields anyhow.

Concerning the fertilising practices however, there is one other possibility: the agency is now-and-then called by inhabitants of the region because they think a farmer is doing something wrong. However, this is mostly because the inhabitants feel disturbed by the accompanying smell of the manure. Often times, in these cases there is no violation of rules. Many interviewees, including the agricultural agency official, said that these complaints often came from people who had moved from the city to the country-side (or

commuting there on the weekends) and who are romanticising the country-life. Sometimes, though, this leads to discovering an actual violation.

This means that the concern of the non-agricultural inhabitants is a factor in information asymmetry, too. In the pure economics sense, it would mean that concerned neighbours who call the agency always would be good for compliance, but in practice this kind of monitoring atmosphere may lead to more opportunism (see 2.8.3). This is why it should only be considered a factor conducive for compliance after thorough investigation. Also, it could be imaginable that if this concern is not realised by calling the agency right away, but rather by talking to the farmers directly, it might have a different impact, possibly supporting social rationality. It may thus be a factor concerning not only information asymmetry.

4.2.1.1.3 Perception of the probability of getting caught

As could be seen, some determinants of the information asymmetry are more or less predictable facts, like the number of systematic controls being conducted and with which time and personal effort they are conducted. Other determinants are less certain, like how deep a specific inspector will dig, or for instance whether a neighbour decides to call the agency. Depending on the perceptions of these factors, interviewees could feel more or less controlled than they are, leading to different considerations of sanctions in their CBA.

As indicated above already, perceptions of the probability of getting caught were very different among the interviewees. The managers of the largest companies said that they feel very much under control and that they actually have several controls each year. On the other hand, these farmers were very aware of the limited effectiveness of the controls. They said, if a farm makes a good impression overall, the control will be very quick and superficial. The medium and small farms (sizes relative to the region) were controlled less frequently or even very seldom. In those cases (medium and small alike), some farmers felt pretty secure that a control would rarely come and if it would, then it would be rather superficial. Others however, even if they had not been controlled at all yet, feared controls more because they had heard *stories* about controls from other farmers. Some claimed they felt they would not be able to hide anything at all. Some interviewees said that the inspectors for the standard cross compliance they had met or been told about, were actually very incompetent concerning agriculture and could thus even cause more trouble than a competent official of the agency.

Factors to the perception of this may be on the one hand the actual distribution of controls throughout the region, e.g. large farms are controlled more. Maybe they could also be influenced by strategic distribution of the controls in the sense that they are spread over the region so that many farmers know several people who have been controlled and can

talk about it. Then another factor would be how much farmers communicate in the region, which could be a structural factor. But this is pure speculation at this point, and perceptions were simply very heterogeneous among the interviewees.
This way it may be concluded that managers of large farms are more likely to take potential sanctions very selectively into account, that is, depending on how obvious or hidden violations would be and what kind of impression they leave with the agency.

4.2.1.1.4 Taking potential sanctions into a CBA

Non-compliance incurs the risk of having to pay fines, respectively losing direct payments. Dealing with risk is an issue of how to deal with bounded rationality, in this case incomplete information. In a neutral economic calculation, the probability of getting caught would determine how the sanctions would be taken into account. For example, the fine for not having enough storage capacities for slurry can be up to five percent of the direct payments. Taking up the example from above, a farm which receives direct payments of 700,000 € would lose 35,000 € if caught. Approximately 5 % of the farms are controlled every year. Since the farm is relatively large, the probability of being chosen for a control will be higher, maybe the farmer would assume a 10 % possibility of a control. In the case where the farmer does not try to hide anything through false contracts or similar methods, the effectiveness of the control might be assumed to be close to 100 %. This is why the risk of sanctions could be taken into account with 3500 €, neglecting further factors like reciprocal considerations.
However, the way in which the sanctions are taken into account in the CBA also depends on the farmers' attitudes towards risk. If this should be structural to an appropriate regional entity, it would be of interest here. If farmers are risk avoiders in general, as is suggested by HIRSCHAUER AND GIEREND (1998), then different strategies can be taken to deal with this restricted knowledge. A strategy for a CBA is to take risk into account by putting a risk premium on the expected utility (ibid.). Then, for example, the 3500 would have to be multiplied with an additional risk factor again. Maybe then they would take the potential sanctions into account as, say, 10,000 €. More practically, it may simply be that the farmer decides generally whether he wants to take such a risk at all, given that if caught, 35,000 € will be lost. Naturally, this will be calculated against the required investment, which in case of nutrient balances are rather low as compared to this example of storage facilities, where for a large company with a lot of livestock more than this potential sanction sum can easily be required.
This was naturally only a very simplified presentation to illustrate the economic decision criteria and problems.

4.2.1.1.5 Conclusions on sanctions

In analysing how sanctions are taken into account in an economically rational way, several factors have been identified that are taken into the farmers' analyses or considerations of costs and benefits, and also how they are taken into account, given the restricted knowledge and foresight. These factors and determinants may in turn be used as CIA, or as indicators of the extent of certain CIA, because they are structural for the region or part of the structures or institutions concerning the policy.

For the sanctions as an economically behavioural determinant it is important how high the sanctions are in relation to the farm income, how high the risk of getting caught is perceived, and how the risk of getting caught is valued, that is, what attitude is there towards risk. Important determinants are the sanctioning and controlling regime, the capacity of the agencies to control and the size of the farms in terms of affectedness of CC sanctions, and in terms of possibilities to cheat. The determinants are summed up in table 2 in annex 1, together with all the determinants identified in this research.

As a final remark for this section it has to be added that, of course, this section was to a large degree an analysis of the (perceived) possibilities of cheating. It should by no means imply anything about the interviewees' tendencies to cheat. Most or even all interviewees certainly reported what kind of cheating they think would be possible without actually having utilised these, or most of these, methods themselves.

4.2.1.2 Costs for mineral fertiliser limits and fertiliser planning

Opportunity costs for mineral fertiliser restrictions and transaction costs for fertiliser planning are closely connected. Because of incomplete information, opportunity costs are no absolute costs, but again, perceived costs. The perception of this is closely linked to the approaches towards planning how much fertiliser to use, which is why they are treated in one section.

The main costs of fertilisation are the costs for the fertiliser itself. Aside, applying fertiliser to the field incurs costs as well; but this is only a small side-factor in the context of the compliance with Nitrates Directive rules concerning mineral fertilisers.

According to economic theory, there is an optimal specific intensity (free translation of "*optimale spezielle Intensität"*, e.g. in DABBERT AND BRAUN 2006: 54) regarding factor inputs. The optimal specific intensity is the one which delivers the highest benefit in relation to the input. That is, the marginal output of the invested fertiliser equals the marginal cost of the input factor, assuming decreasing marginal benefits.

When the legislation restricts the amount of fertiliser to be used, it may be that the allowed amount is smaller than the optimal one. In this case, the farmers would have opportunity costs because they have to forego an opportunity to make profit.

The main variables of optimal fertiliser amounts are prices of fertiliser and other inputs, prices for sold products, and last but not least the productivity of the production site.

In theory, the legislator has not demanded from the farmers to use less mineral fertiliser than is optimal for their production – under the practical assumption that mineral fertiliser is not almost costless and the prices for goods not excessively high! This is because what the legislator demands is that N surpluses going into the environment rather than into the plant production, should be held minimal. Physically, from a certain amount of fertiliser on, the soil and the plants will not take up any more fertiliser. Thus any additional fertiliser application would be a waste of money. That an optimal provision of nitrogen for the plants is always accompanied by certain amounts of losses has been acknowledged in the legislation, allowing for a respective degree of N surpluses (see 3.2.5). This way, from the view of the perfectly economically rational farmer, he would thus not want to use more mineral fertiliser than the allowed amount. For manure it is a different topic, because for applied manure there are upper limits, and also manure is free for some farmers, see section 4.2.1.4.

The problem with this and the reason why it had to be put on the political agenda, is that perfect rationality is not possible, especially because of the characteristics of the natural system as well as the market system involved. The uncertainty connected to some factors of these systems mean that perfect planning is not possible.

For the natural system the unpredictable factors that determine plant uptake of N and N losses involve such as the rainfall, the temperature sum, the sunshine hours over the growth period of the plants, the heterogeneity of the soil, and plant health.

Unsecure factors of the market system are the demand and supply and prices of input factors and for products.

Actors can use different strategies to cope with these conditions of imperfect knowledge, which can be regarded in two steps: firstly, making assumptions about what the most probable N demand of the plants will be and secondly, deciding whether and what amount of additional fertiliser shall be applied for security reasons.

For the first step, there are two main categories of strategies:

One is to make thorough calculations about the optimal fertiliser input with assumed factor values, based on own or representative soil and plant analyses and forecasts of future weather and yields. Let's call this the *calculation strategy*.

The other one is less based on calculations but on personal observations, impressions, experience, and rules of thumb. To the extreme, it may be based on gut feeling in which these information are reflected. Let's call this the *gut strategy*, just for illustrative purposes. These naturally are the extremes, and real decision-making can be assumed to be usually a mixture of both.

As the second step, the decision-maker has to decide whether he will apply this best-guess-optimal amount of N or whether he wants to apply more, in case factors change favourably and plants could make profitable use of more N. This will be called *security add-ons* based on ECKERT ET AL.'s (2000) writing about farmers' *"safety thinking"* in N fertilisation. Part of this can naturally already be entailed in the first step by making certain assumptions on different factors but for the analysis of determinants it is important to distinguish these two steps.

The Nitrates Directive demands from farmers firstly to use the calculation strategy and secondly not to use security add-ons. Calculation is seen as allowing for better guesses concerning N uptake of plants than just the personally perceived experience of individuals. And not putting security add-ons avoids unnecessary leaching.

This procedure may be seen as optimal by some farmers. For others it may be seen as putting them under constraints and causing them opportunity costs by raising their transaction costs.

When the calculation strategy is used, the actors assume that with thorough calculation, the probability that the economically right amount of fertiliser is used, is higher than otherwise and that the effort to conduct the calculation is worth it. In more analytical terms, the transaction costs of the calculation are lower than the assumed benefit of the generated information.

The advantage of the gut strategy is precisely the avoidance of those transaction costs. The underlying assumption of this is that the time and effort spent on the calculation are more costly than the potential bad guess. Also, inherent in this strategy is obviously that the *guess* based on observation of the development of the plants, and rules of thumb, which may have developed regionally specific over a long time, may not even lead to worse guesses than the calculation. Some Scottish farmers, for example, claimed *"that they 'know what's needed by the appearance of the crops'."* (MACGREGOR AND WARREN 2006: 115).

However, from the point of view of environmental policy it is much more secure to rely on people making sound calculations, which can be retraced and monitored, than to hope that farmers are able to make good guesses without calculations, which do not lead to unnecessary leaching.

Thus, decisions on the amounts of fertiliser to be applied depend on the price of the fertiliser, the other assumed factor values and their probabilities and, again, the attitude towards risk.

4.2.1.3 Determinants of costs and cost perception for mineral fertiliser rules

Regarding the costs for mineral fertiliser restriction and planning, the determinants of a successful policy implementation in a region are those which determine which strategies actors follow independently of the policy, how open they are to those strategies prescribed by the policy, and how the policy is communicated to the farmers. From an economic rationality perspective, these factors play a role solely in the way they shape farmers' perceptions of their costs, for instance, which planning strategy seems more cost-efficient to them. Information on the policy is an own cost category, and will be analysed in 4.2.1.6. Additionally, sanctions play a role in determining the CBA of a farmer in general, which was analysed in the last section.

In the study area, the calculation strategy is relatively well adopted. Although controls found some violations, the major share of farmers, and especially the larger companies used this strategy. Other studies showed, that there are some serious discrepancies in other regions, which gives reason to look more closely at the determinants. For example, in a study in Scotland, BARNES ET AL. (2008:11) found that only *"around 62 % of farmers within an NVZ claimed to prepare a nutrient management plan. In addition, around 90 % of these farmers claimed to keep records of fertiliser and manure applications for individual fields".* In another NVZ in Scotland, compliance with nutrient budgeting and soil tests were done even more seldom (MACGREGOR AND WARREN 2006: 115).

A study which is interesting in regard to security add-ons is about pesticides application on fruit trees in Turkey. Similar as with the Nitrates Directive, in Turkey there are regulations which allow farmers to use only certain amounts and certain kinds of pesticides. ISIN AND YILDIRIM (2007) found out that those regulations in Turkey were frequently violated, and not just where the regulations were actual constraints for plant health but also where economically recommended amounts were not trusted.

In the interviews with farmers in Märkisch-Oderland, it initially seemed that independently of the variation in their characteristics, the individually chosen strategy of farmers was what is demanded from the Nitrates Directive anyway. Almost all interviewees said they would do as much of analyses and calculation as was demanded from the legislation on their own account, often times even more intensely, sometimes only a bit less intensely[11], or simply a little different within the calculation strategy. The older ones also said that this calculation strategy, respectively a partially even more elaborated version of it, had been practised in the GDR cooperatives already, except that some methods were not available at earlier times.

[11] There were actually a few farmers who said they would do less paper work for themselves, but it turned out that in these cases it referred more to the record-keeping and less to the actual analyses and calculation, and thus is more of an issue about transaction costs for burden of proof.

However, the differentiation among interviewees was only relative to the region, which means, for example, that small farms in MOL would still be considered large in some other regions like in Bavaria. It seems that some of the studied factors do matter, but that there are certain thresholds to when they actually become constraints to the policy implementation. The evaluation of the case study together with a literature study, under consideration of the economic theory, led to the following determinants. One of those determinants is the information on the policy but it will be discussed in an extra section because it is not only a determinant in this context but a cost itself.

4.2.1.3.1 Farm sizes

In spite of the lacking variation concerning the fertilisation planning practices among interviewees, upon request some farmers said that maybe when a farmer has only very few hectares or has a totally different educational background, they might choose a different strategy.

Concerning the size of the farm some interviewees had the thought that maybe with an acreage of around 50 to 80 ha or less the whole calculation process might not be seen as worthwile by some farmers. One manager of a very big company even said that if he managed an acreage of *"only"* around 300 ha he would actually do much less calculation, would rely more on his own experience and rules of thumb and would restrict to doing the math in his head.

Reasons for the sizes of farms being a strong determinant are on the one hand that the more hectares managed, the more losses are risked if too much fertiliser is applied per hectare. On the other hand, it is because on a smaller acreage an overview can more easily be kept without documenting everything, thus the risk of over- or under-fertilisation on the ground of a gut strategy would be much lower. And at the same time the transaction costs per hectare for the calculation strategy would be higher for a small farm.

The sizes of farms also play a role in the uptake of information about new policies. The largest farms had managers who are much specialised, and who have more time for dealing with new policies and to look for information on how to deal with new restrictions. This will be explained more in section 4.2.1.6. The effect of large farms' labour organisation is independent of larger farms often having better educated staff than small farms, because this differentiation was also found among university graduates of similar age groups.

The relevance of farm size is also confirmed by the official of the agricultural agency of the region.

The Scottish evidence might also hint to this correlation because the farms there are on average 133 ha (BARNES ET AL. 2008: 9), which is not very small, but there may still be more small farms than in MOL, depending on the statistical spread of farm sizes.
An actual threshold for when farm size becomes constraining cannot be determined here. Naturally, there is also not a strict threshold, but a fluent transition. For a lot of medium sized farms' managers it may be more difficult than for managers of large farms, but still possible, to take some extra time doing research on new developments. Small family farmers usually have extreme time constraints on such research because they have too many tasks, and thus even may not have much practice in doing it efficiently. However, at that point, education will play a role. This way, in a region where even small farmers are well educated and motivated, the meaning of size may be different than in a region where small farmers are usually less educated and open.

4.2.1.3.2 Education and openness to learn new practices

Even though the interviewees differed in their educational background they still had similar approaches to fertiliser planning and security add-ons. However, two interviewees knew some farmer or had heard of one who had done some things unplanned, including fertilisation, and had finally gotten into trouble. At least one of those farmers had to face sanctions; and at least one of them had problems with his production costs. Those farmers did not have an agricultural background at all. One interviewee said to this, that there were hardly any people like this in the region anymore, because either they learn quickly to be a good farmer or they fail soon. This, by the way, reflects also that this interviewee who is a manager of a *"small"* family farm herself (around 300 ha arable land) really perceives the calculation strategy more cost-efficient, and not just because of the policy.
This means that the variation of the variable *education of the interviewees* was actually small when considering that the threshold was below their lowest quality of education. Despite having this little variation, it may be interesting what the common factors in interviewees' educations were. All farmers thought that their education was a good or even very good basis for their farming practices. One farmer who had done both, an apprenticeship and university studies said that the apprenticeship, not the university education, was crucial for the Nitrates Directive rules. They all valued continuing education highly, even though some farmers said, they had only very little time for it. The two young *"Gesellen"* also said they thought about becoming *"Meister"* as well (see glossary).
These evidences suggest that, as indicated above, education does play a crucial role in adopting the policy, but the question will be which level of education is necessary in each

region. Here, for example, it seems like it does not matter whether a farmer has a university degree or only done an apprenticeship, as long as it was in the farming sector.
However, the three of four young interviewees with no university education were very motivated to learn more and open to new practices. This suggests that not just the educational background plays a role but also the willingness for continuing education in the broadest sense. After all, the older farmers may have had a good education according to the circumstances in the past, but this may not be appropriate now. Ongoing education here is meant as, for example, reading professional journals, going to trainings and small courses as well as actually gaining an additional degree.
The relevance of education as a constraining or conducive factor is also found by others: LEMEILLEUR (2008) found lack of education a constraint in the implementation of NVZ requirements in the Midi-Pyrenees. ISIN AND YILDIRIM (2007) say that many fruit growers in their study region in Turkey were actually relatively environmentally aware; however they lacked knowledge using pesticides appropriately. Also, they did not trust recommendations and for this reason applied more pesticides than necessary and allowed. This was attributed, besides age and experience, to the education level.
In this sense, higher age would be recognised as compensated by continuing education in Märkisch-Oderland since the case study shows that age plays a very minor role compared to the education (age plays a role in environmental awareness, though, see section 4.2.2.3).
Also BARNES ET AL. (2008), while not explicitly naming education as a determinant, still suggest it plays a role, considering that farmers there found paperwork too demanding, and were not well informed while having very similar information sources as the farmers in MOL (see 4.2.1.6).
This willingness to receive ongoing education naturally would need a qualitative assessment for each region. The education level may be more easily to assess, if there are available statistics on this. But if this willingness for ongoing education is a factor, then a structural factor of the region will also be what possibilities in the region are available for continuing education. Generally in MOL, continuing education in the region is not available from the state side – except for "Winterschulungen" (few-days-information events during the winter) which only impart the latest cross compliance requirements to the farmers, as the interviewees said, but that is rather an issue of information on policy. Other educational possibilities at relatively low cost (mainly at the Brandenburgische Landwirtschaftsakademie (BLAk), a publicly supported regional academy offering courses mainly for staff members of farms and consultants, and partially courses offered by professional associations are rather constrained in terms of the topics, and not helpful for the fertilisation issues. In terms of the number of being named, seminars of farming supply

companies were most important for the farmers. Interestingly, there was only one single farmer who noted this critically and wished for more neutral courses for farmers. On the whole there were very different opinions among farmers on whether they have enough possibilities for continuing education. This may suggest that the negative answers stem more from the expectation that the state should offer more possibilities for free or at low cost, so that the willingness to ongoing education and to invest in the same is pointed out as a factor again. Aside it might also be that the positive answers stem in some cases from little ability to criticise especially the industrial representatives.

4.2.1.3.3 Trust

In this section of the economic rationality perspective, trust is most important in regard to trusting in the recommendations for fertiliser use. According to BARNES ET AL. (2007:2) several studies suggest trust, respectively conversely *"lack of believe in scientific evidence amongst farmers",* to be a crucial issue in the implementation of compulsory rules in agriculture, including their own study about NVZ in Scotland. MACGREGOR AND WARREN (2006: 115) also found that most farmers did not trust that with nutrient budgeting and more frequent soil analyses they would have more accurate results compared to their usual estimation of plant and soil needs which did not include elaborated nutrient budgeting and less soil analyses. Similarly, lack of trust in pesticide recommendations was found as a constraint by ISIN AND YILDRIM'S study in Turkey (2007: 922).

Concerning compliance with agri-environmental regulation in general, this is also supported by findings of WINTER AND MAY (2002: 118): *"Our basic point is that information, advice, and persuasion are more likely to motivate regulatees to agree with a regulatory message if regulatees find the source competent and trustworthy. Regulatees are also more likely to seek advice from such sources."*

Aside, trust plays a role in cooperation among farmers as well but this may be of less importance here since cooperation is mainly done regarding giving and taking livestock manure, which is a rather simple and transparent transaction, and also with little pressure since manure is rather lacking in the region, see 4.2.1.4.

While trust is an important issue, lacking insightful variation in the case study, it can only be guessed, that from the farmers' side trust comes with the education and willingness/capacity to learn, so that they can distinguish better whom or which information to trust and at the same time understand the information itself better.

Crucial for this factor is also, whether the sources of information are actually trustworthy and how they communicate this, which is a question out of the focus of this research. But some things can be said about who is perceived to be trustworthy by farmers in which questions. In WINTER AND MAY'S study (2002) about compliance of Danish farmers with

agri-environmental regulation they found out that regulatory agencies were trusted in terms of getting information on what rules have to be complied with. But trust in the agencies beyond this was very low while higher for information sources that were affiliated in one way or another with their interest groups. Which sources are trusted, again, has to be assessed qualitatively in each region. For example, in MOL farmers' trust in the agricultural agency was rather high, based on good cooperation and seeing their interests understood by the agency's staff. Trust is also an important issue in social aspects (see 4.2.2.2 and 4.2.2.3).

4.2.1.3.4 Prices of fertilisers

Farmers also emphasised frequently, that mineral fertiliser simply is very expensive and that they could by no means afford to waste any, especially with the exploding prices in the last years. From 2007 to 2008 prices for mineral fertiliser doubled and demand actually sank 16 % (AGRARHEUTE 2009). Even though prices for agricultural products have risen as well, this was not to an extent that it could have compensated for risen input prices. Accordingly, the high fertiliser prices account for not using security add-ons, or at least low ones.

Even though this was a strong argument for the calculation strategy, the interviewees who were older said, they had always done it like this, because mineral fertiliser has always been so scarce that using too much or letting it go into ditches would have wasted too much money (in eastern as well as in western Germany). Only two older people said that they remembered single incidents, several decades ago in the GDR, where fertiliser was easily available, and on some farms it was applied very intensely without considering the actual plant need. This again, refers only to mineral fertiliser.

4.2.1.3.5 Production capacity of sites and cultures

As explained above, for mineral fertilisers, certain N surpluses are allowed. For the security add-ons, which go beyond the allowed surpluses however, interviewees suggested that there might be a correlation with the production capacity of sites, and also with more or less demanding cultures grown on the respective sites.

There is, on the one hand, the view that on poor sites farmers tend to apply more fertiliser than necessary, because they want to make sure that they use every chance to get better crop yields, like in case climatic conditions would be better than expected. On the other hand, there is the view that only on the more productive sites it is worthwhile to risk spending too much fertiliser because the marginal benefit of the fertiliser is higher. The same logic accounts for excess fertilisation only being worthwhile for more valuable

cultures; especially such which need more nitrogen and thus have even higher marginal benefits to the nitrogen.

In the interviews only the second view was represented. However, it was only represented by the farmers on the poorer sites, who said that *if excess fertilisation was useful at all*, it would be on the better sites in the Oderbruch with the more valuable cultures. The farmers who actually managed those better sides, did not confirm this. They had the same view on saving mineral fertiliser as the farmers on the poorer sites. This was confirmed by the official of the agricultural agency. Then again, even though there are some very fertile soils in the Oderbruch, on average, production capacities are still not as good as in a lot of other regions.

For example, in a region in the Auvergne, the implementation of a NVZ was found to be constrained by bargaining power of farmers' organisations, which was used by farmers because opportunity costs were seen as high there. This was because the region is characterised by rather rich soils and farmers produce high quality crops with high N demand like high-protein wheat, maize, and wheat seeds (SCHLEYER ET AL. 2007b: 14,30,31). But this is only speculative evidence for higher opportunity costs on more fertile soils, and higher quality crops in general. It might just be that farmers mainly use manure in that region, which would mean they are affected by upper limits more than farmers who need to add fewer nutrients. Or it could be that they do not trust the calculations and want to add security add-ons. Then the primary problem might not be the production but education, information, farm size or else. The farms there are much smaller with 49 ha average (ibid.: 14) than in MOL. Finally, NVZ rules in France may be slightly different than the German DüV rules, since the Nitrates Directive leaves some latitude for national and regional implementation.

This way, no definitive conclusions can be drawn concerning the determinants production capacity and cultures. However, ECKERT ET AL. (2000) found out in a study of 125 farms totalling 130 000 ha in 11 German states, that there was no significant correlation between productivity and excess fertilisation. They found that on the one hand, *"even very high yield levels [...] can be consistent with tolerable N balances*." (ibid. 349). On the other hand it turned out that the security add-ons were used on all kinds of sites with the logic of not restricting plant growth by insufficient nutrition.

4.2.1.4 Costs related to livestock manure rules

Above, the determinants of compliance with rules about mineral fertiliser were analysed. There are some major differences in livestock manure fertilisation, which is why it needs an own analysis. However, several determinants are the same and their influence mechanisms very similar. This is why only the differences will be highlighted here.

For manure, the rules for making fertiliser balances and planning are the same as for mineral fertilisers. But additionally, there is a different rule: There are actual upper limits to manure application, independent of the balances. Secondly, beside the rules, the second major difference of manure as compared to mineral fertilisers is that manure is usually much cheaper than mineral fertiliser and in some regions even so abundant that it is much cheaper to spread the manure excessively on the field than to dispose of it in another way.

Thirdly, fertilisation with livestock manure is also related to the question of storage of the same. If there are not enough storage facilities for manure, farmers have more incentives to spread the manure under conditions where leaching is high. This is why part of the Nitrates Directive legislation is on storage facilities (implemented mainly via the VAwS in Germany). If animal manure is caught as slurry, the storage facilities have to be so that the occurring slurry can be stored for at least six months. Old facilities had to be modernised by the end of 2008. Exceptions can be made if it is proven that the slurry will still be used environmentally friendly[12]. For solid manure the facilities have to be so that the slurry that drains from the manure does not enter the soil but is caught appropriately (*"wasserundurchlässige Bodenplatten mit Sammeleinrichtung für Jauche").* The regulation on size is rather fuzzy but in general capacities should be big enough to allow for environmentally safe management. Field middens are also allowed but regulations can be specified by the state governments. This way, in Brandenburg field middens were allowed for three months initially, but since August of 2007 for six months.

Several kinds of costs may be created for farmers through these regulations.

In certain cases farmers have opportunity costs in terms of the upper fertiliser limits: If plant demand is higher than the allowed 170 kg N/ha for arable land, the additional amount would have to be added by using the much more expensive mineral fertiliser, even if enough manure would be available.

Not being allowed to use security add-ons may be seen as opportunity costs by those farmers who have relatively large amounts of manure at their disposal. This is, on the one hand, because if the manure is very cheap (or even has to be costly disposed of), it

[12] Since this has to be checked and decided by the regional administration, there is some scope to the implementation of this rule which depends a lot on regional administration and regional politics but this is not in the focus of the main study.

seems economically wiser to use as much manure as might be useful under the best climatic conditions, so that nutrition will under no circumstances be the restriction for plant growth. Furthermore, N values and N release characteristics for manure are rather inconsistent compared to mineral and chemical fertiliser which makes security add-ons even more interesting. This was also an argument by some farmers.
Farmers might also be less motivated to make balances and fertiliser planning, because it is more complex and involves higher transaction costs regarding determination of the N value of manure and calculation.
Finally, in cases where enlargement or modernisation of storage facilities is legally demanded, farmers can encounter very high costs so that they have strong economic incentives to avoid compliance.

4.2.1.4.1 Manure amounts

Because of the manure problem, there are regions in Germany, where nitrate is a much bigger problem than in MOL. These are mostly areas in Lower Saxony, Schleswig-Holstein, North Rhine-Westphalia and Bavaria, where there are areas with very dense livestock populations (BMU 2004:27).
Actually, four of the interviewed farmers grew up in Lower Saxony and North Rhine-Westphalia. They emphasised, that the problems in their home regions had been, and partially still are, much worse than in MOL. One said, in his childhood days, many farmers had spread slurry whenever they had time for it, because they wanted to get rid of it, and they were not aware of the environmental consequences. However, the Nitrates Directive has in these cases been very effective. Even if there are still problems, there is much more awareness and practices are usually not as extremely bad anymore, according to this interviewee.
In Märkisch-Oderland there is a rather small livestock population so that manure on the whole is actually scarce and even imported from as far as the Netherlands (according to several interviewees including the agency). Problems with manure may still occur in such a region because those farms with a lot of livestock can still have bad practices.
In MOL, for example, the nitrate and ammonium problems might have been influenced, among others, by livestock manure problems in GDR times. In those times livestock populations in the cooperatives were bigger, but supposedly in the whole region still not as dense as in the very problematic regions in western Germany. However, some older interviewees explained that problems still occurred for the following reasons: animal production was concentrated in several big cooperatives which were mostly organised as own cooperatives, separately from the arable cooperatives. This way, a lot of manure occurred within small areas, and because these cooperatives did mostly not have much

arable land themselves, no specialists for plant production, and probably scarce storage capacities, slurry and solid manure were partially disposed of in a manner to get rid of it quickly rather than to use it efficiently. That is, there were some agreements with arable farms, but still there were not enough economic incentives to transport the manure far enough to spread it on appropriately large areas. Also, they did not have incentives to apply the manure only at the right time and under the right conditions, avoiding leaching. Even though several interviewees emphasised strongly that in GDR times there had already been a lot of knowledge and environmental awareness, the arguments of other interviewees who told of actual bad practice examples which they remembered, and not just some general statement, seemed more convincing. Those interviewees also said that the knowledge had been there for some time but that this knowledge was not necessarily there with the animal production cooperatives and that economic aspects had priority and did not favour best practices with manure.

Nowadays some of these problems can still be found in a milder form. While the managers of the farms with a low livestock density did not have any problems with fertiliser amounts, the managers of farms with more livestock still encounter problems. Problems with storage facilities were also encountered by some farms with lower livestock densities.

Three of the interviewees of the farms with highest livestock densities said that they would indeed like to use more fertiliser than allowed, not just in terms of the upper limits but also in terms of security add-ons. One farmer actually admitted that they applied more fertiliser to some fields, which is easy to hide with the many fields they managed. This way the overall balance of the farm was okay. This farmer also claimed that spreading the manure costs money in terms of work and fuel as well which is why they prefer to add it rather concentrated on fields nearby the animal production facilities. The other two farmers said the manure amounts they apply are always at the limit.

However, these farmers thought that they did not harm the environment with this. In one case this was because the additional amount would have been within the nitrogen balance, just not within the allowed amount of N from livestock manure. In the other cases it was because the farmers said losses of N during storage and spreading were not acknowledged enough in the reference values for N content of manure. This shows that farms with relatively high livestock densities have – or at least perceive to have – the first two kinds of opportunity costs described in the beginning of this chapter (limits for total manure amounts and security add-ons of fertilisers).

The important variable here is not just the livestock density of the whole region, which is low in MOL, but within the low density also how concentrated livestock production is

locally because the manure could easier be spread on different fields if there was a more even distribution.

Concerning the factor of concentration and farm size, it is also evident that mistakes on farms with many animals have bigger environmental impacts than on farms with few animals. An example was given by a Czech agricultural scientist (PRAZNAN 2009) who had worked on a large farm for some years. One time someone of this farm spread slurry on arable land, on which a well was situated, when the soil was still frozen. The slurry went into the well, and spoiled the water for the cattle that refused to drink the water for good reasons for at least one day, which was a big problem for the company even without regarding external costs.

4.2.1.4.2 Storage

While the opportunity costs for manure limits were rather limited and for a lot of farmers in the region not existent due to weak availability of livestock manure, more farmers encountered problems and costs concerning storage facilities.

Storage facilities for slurry consistent with the Nitrates Directive requirements bear high costs. One farmer whose company was affected by the rules for storage of slurry was very angry because he claimed that the storage capacity of six months was not necessary in this region as the time when he would not be able to spread slurry was in his opinion three months at the most. Some interviewees agreed with this view but more farmers opposed it because the closing period alone is three months, after which for several weeks or even months it is not possible to spread manure due to wet or frozen soil, and even right before the closing period it is not always possible to apply manure without damaging the soil, or it is not the right time for the crops.

Two farmers said that for them the storage requirements were reasons not to have animal production because the investment costs are too high. Other farmers said it was a reason for them not to change their production system from solid manure to slurry. In general, for those who have slurry those requirements pose serious costs. This is why, one of the interviewees said that in his relatively large company, they have been cheating just a little to avoid those costs as long as possible. Other managers said, though, that they see these costs as normal production costs and that they find it useful for their production to have the possibility to store the manure for six months and to be flexible in the application. However, it is obvious that those companies were in economically better situations and thus could afford this attitude.

Since for storage of solid manure, requirements are not as strict as for slurry, there was less controversy about them and less problems with them. However, this was said to have been different until shortly before the interviews, when field middens where only allowed

for three months. In this context it was also so that one farmer said frankly that it was too expensive for him to build the required additional storage and that he cheated with the field middens. He left them on the field for longer time periods than three months. Several farmers indicated this as well. Whether this prolongation is wise in terms of water protection cannot be answered here. Even some farmers doubted the environmental usefulness of this rule change. Focussing on the farmers' compliance, though, it can be concluded that cheating is relatively simple in the point and that it was done too, because storage costs are high, but is now not necessary so much anymore.

In general farmers who had cost problems said that also with the investment support of the state which was up to 40 % of the costs it is still not feasible for them. The same has been observed by MACGREGOR AND WARREN (2006: 116) in an NVZ in Scotland. At the same time, while those who made those investments in MOL and did not find it very difficult, said they would have done it without support as well.

An important cost factor regarding manure storage and application is also cooperation between farmers. Some of the larger farms with a lot of animals have exchange with arable farms that like to use their manure. Normally, costs are shared in one way or another. In one case the company having the manure delivered it, but the recipient paid the costs of fuel for the transportation. In another case two companies exchanged manure against straw as bedding. Some large companies in the region even import manure from fur-farms in the Netherlands; however in that case, the positive environmental impact is certainly questionable. In a respective example in the interviews, the transportation costs were directly equally shared. Several interviewees told about two large poultry production companies in the region from which they received manure. This way some degree of social capital and trust, which allows farmers to cooperate, is necessary for the implementation of the rules.

Contrary to MOL, in an NVZ in Scotland, farmers had trouble doing this cooperation (MACGREGOR AND WARREN 2006: 116). It is not quite clear from the text whether this may have to do inter alia with lacking social capital or only with the high density of animal production in the region.

4.2.1.5 Opportunity costs regarding rules for application

Additional application rules are to keep a certain distance to water bodies, including ditches (normally 3 m); to pay respect to the absorption capacity of the soil in regard to wet and frozen soil and the relief (however steeply sloping fields are rare in the region); not to apply fertiliser in the closed periods (1st November to 31th January); and not to apply more than certain amounts before the winter (max 80 kg N/ha, max. 40 kg N/ha from

Ammonium fertiliser, and no liquid organic fertiliser at all on soil that lies bare during the winter).

The compliance with these rules depends mostly on whether they are economically beneficial for the farms or else whether social aspects lead to compliance because monitoring is hardly possible. This latter factor was discussed in 4.2.1.1.

Concerning the pure cost-benefit relations of the rules farmers perceived following things:

Most farmers claimed that keeping the demanded distance to ditches is economically sensible because they do not want fertiliser to be wasted when it goes into ditches. However, some farmers remembered that it had not at all always been self-evident. Also, some farmers said that this regulation was totally new. Truth is that the distance of precisely 3 m is new but in older versions of the DüV it was also stated that a *"sufficient"* distance has to be kept. This suggests that those farmers may not really have been aware of the issue of proximity to water bodies.

Effectively, opportunity costs from keeping 3 m distance from water bodies means that even for every 100 m of ditch, an area of 300 m^2 has to be virtually excluded from the production. That this can sum up to some significant opportunity costs is reflected by some farmers investing in certain equipment for spreading at boundaries (*"Geräte mit Grenzstreueinrichtung")*, and others in drag hoses for slurry application with which fertilisation is allowed until 1 m beside a water course. One of those farmers said that using these, in the form that they had it in his company, involves opportunity costs, too, (besides the actual purchase) because every time the tractor-driver comes close to a ditch, he or she has to stop, go out and fix a device to the fertiliser spreader.

It becomes clear that from a purely economic perspective a farmer might not keep the required distance or invest in those special implements, since there are not necessarily enough economic incentives to it. The argument that the farmers do not want to throw fertiliser in the ditches anyway distorts the meaning of the rules because those demand that the outer edge of the spreading width must not be less than 3 m from the watercourse.

Also opportunity costs are involved in the restriction of amounts to apply before winter. Actually, farmers did not believe that these rules were meant for solid manure as well because it releases nutrients only slowly. The respective interviewees said that in some cases it was vital for them to apply certain amounts, which are higher than allowed, of manure in the winter on bare soil because in the spring they would not be able to, due to the wetness of the soil. They were convinced that what they did was not against the rules.

Closed periods were seen by almost no interviewee as a problem at all. Two mentioned that they would find it more useful to have the closed period a bit later because they said

in the early winter it is sometimes really still dry enough but in February, after the closed period, they cannot go on the fields anyway as it is normally too wet.
Concerning wetness it seemed that the interviewees really did not see any costs involved because they were all very aware about the damage that can be caused to the soil which decreases the production capacity of the soil. This is obviously due to a certain degree of education which had not always and everywhere been given, or else the rules would not have been needed in the first place.
Also, concerning frozen soil, the farmers said that they would not be interested in applying fertiliser on deeply frozen soil. On lightly frozen soil which thaws during the day, it is actually allowed and even seen as an environmentally friendly practice by the farmers, because the soil will be damaged less when going on the slightly frozen soil in the morning, with the fertiliser entering the soil later in the day.
In spite of the costs involved in the compliance with some of these rules, most farmers claimed to still comply with them. This is why determinants for the compliance on these points will be discussed in the normative rationality section 4.2.2.

4.2.1.6 Information costs and information as shaping cost perception

For one thing, information on a policy can be a determinant of cost perception, because it may for example communicate advantages of certain strategies to cope with bounded rationality, as in the case of fertiliser planning.
None the least, information is also a cost for the farmers' compliance itself because they need to invest time and money into getting information and learning new practices.
Influence on farmers' perceptions of production costs, as well as on their information costs are determined by the supply with information and extension services, and how it is taken up.
In several other regions, information on policy was seen as a constraint of the implementation in one way or another (e.g. in a region in the Auvergne, SCHLEYER ET AL. 2007b: 24; in a NVZ in Scotland, BARNES ET AL. 2008: 18; in the Midi-Pyrenees, LEMEILLEUR 2008).
In the study regions' state Brandenburg, there is no extension service from government agencies. Consultation, not connected to promoting certain products, has to be sought in private firms and paid privately. The state agencies do give a minimum of information. For example, they sent out an information brochure about the changes in the DüV when it was significantly changed in 2006 and 2007 (LVLF 2007). They also had an information brochure for farmers that listed the major requirements for cross compliance (current version at the time of the study: MLUV 2007), and there is a brochure with reference values, which may be used for the calculations (current version at the time of the study:

LVLF 2008b). Additionally there are information events of the regional agricultural agency in the winter each year, at which farmers get some basic information about news in compliance matters. These however, according to the farmers, are rather superficial and not supportive in terms of fertilisation planning and application. There is also an internet portal which gives some information for registered farmers, however not so much concerning fertilisation, but rather pesticide application. In general, farmers in the region also have other information sources but they did not consider them crucially supportive for the nitrogen fertilisation regulations (see 4.2.1.3.2). That other information sources may have played a role in legitimating the policy is a different question (see 4.2.2.2).

All interviewed farmers said that information given to them was sufficient for being able to comply with the rules. However, several farmers pointed out that better or more information or even training courses could still be very helpful. A clear distinction could again be observed between different sizes of farms. As noted above already, the bigger the company, the more specialised the respective manager, the more the latter one can thus focus on the office work, the more they felt information from the state was really sufficient. Smaller and medium sized farms' managers have more trouble keeping up with changes in legislative requirements. For example, some farmers were not aware that the period for field storage had been prolonged from three to six months.

An example for how having more time for research may save time and money is the following: a lot of smaller and medium sized farm managers either had invested in expensive computer software for fertiliser planning, or wished to do so if it was not so expensive. Some of the ones who had invested in it already said that the software was not only expensive in terms of buying the product and frequent updates, but also was very complicated and time-wise expensive for learning to use it efficiently (one farmer said, he should have stayed with doing simple tables by utilising spreadsheet-applications such as Microsoft Excel). And in contrast to this, a manager of the biggest and wealthiest company interviewed used a simple program which can be downloaded for free from the website of the agricultural agency of the German state Saxony-Anhalt (LLFG 2007). He said that this program was totally sufficient for fertiliser planning – but naturally it needed some (competent) research on the internet to find it first[13].

Contrary to the interviewees, EWERS AND HENRICHSMEYER (2000: 64) point out that the lacking extension work in Brandenburg is actually a problem for agri-environmental policies. There are several possible explanations for this discrepancy. Firstly, EWERS AND HENRICHSMEYER do not only refer to the nitrates policy. Secondly, their report was

[13] Of course the utilisation of different software will cause different results, when applied by different individuals. Expensive software may pay off, but, given that this professional field is not linked to a strong technology affinity, the required preparation and study of the methods may prove as not worthwhile.

published in 2000. The situation concerning extension may not have changed that much, however information on policy may have improved, mainly through distribution of cross compliance and other brochures. This idea is supported by the statement of the agricultural agency official, who said that when they first started cross compliance controls there were several minor violations against the Nitrates Directive, especially against fertiliser planning and record keeping requirements, and that this has already improved significantly because of cross compliance, not just because of the threat of controls and sanctions but also because of information given with the distributed brochures. Similarly, SCHLEYER ET AL. (2007b: 24) write that in a NVZ in the Auvergne, in France, farmers' knowledge about the rules was significantly improved through an information campaign prior to the introduction of cross compliance. But probably information improved also because farmers had higher incentives for informing themselves when CC sanctions were introduced.

It has to be added that quite generally all farmers found farming regulations too complex and not communicated well enough. Even though most interviewees could in the end deal with it all in all, informing themselves involved high transaction costs in terms of time and effort. During the interviews it turned up that even some of the managers of large farms had missed some specific information about the Nitrates Directive to the degree that one had higher manure storage costs than necessary. Many interviewees said, regulations were simply too many. But one manager said that, independently of the amount and complexity of regulations, it would make compliance already a lot easier (and thus less costly), if information would be given to the farmers in a more structured and consistent way. He said that he would be willing to pay for such a service, which offers well structured overviews of changes that are relevant for farmers.

Contrary to the MOL case, in some NVZ in Scotland information on policy seemed to be a real constraint. BARNES ET AL. (2008: 18) say that "i*nformation to farmers in NVZs is not adequate since some are not aware of the regulations at all, others are not aware of details such as grant funding and consultation about revisions."* This is especially interesting when considering that the actual flow of information in Scotland was very similar as in MOL at the time of this study. BARNES ET AL. conducted their study in 2007, only one year earlier than this study in MOL, and also two years after the introduction of CC. The main information flow in MOL were the above mentioned brochures, i.e. brochures about CC requirements which were given to recipients of direct payments as well as a brochure on the changes of the DüV and a brochure with reference values for fertiliser balancing and the like. In Scotland too, all the *"occupiers in NVZs"* received a letter with a brochure about the NVZ requirements in 2003, also with recommendation and reference values (SCOTTISH EXECUTIVE ENVIRONMENT GROUP 2003), complemented by

some workshops (ibid). Additionally a brochure about CC requirements was distributed in 2005 (SCOTTISH EXECUTIVE 2005). Even though the details of the information flow in Scotland are not available for this study, evidence does show that the information distribution cannot have been significantly weaker than in MOL, but posed a bigger problem there. Again, the Scottish evidence might hint to the relevance of farm size because managers of smaller farms may have more trouble keeping up to date with information. Some Scottish farmers also actually suggested to make the requirements easier for small farmers[14] (SCOTTISH GOVERNMENT ENVIRONMENTAL QUALITY DIRECTORATE 2007: 5). This assumption that farm sizes matter in terms of office work is also supported by the Scottish farmers finding the paperwork of the NVZ requirements far too complicated and also needing too much time (BARNES ET AL. 2008 and 2007:40). The statement about complicated paperwork though, also hints to that maybe farmers are less well educated there. But that is mere speculation.

Accordingly to these findings, in a proposal for amendments to the actions programme for NVZ, the SCOTTISH GOVERNMENT ENVIRONMENTAL QUALITY DIRECTORATE (2007) suggests to improve implementation by offering training for farmers. Also, farmers in Scotland wished for *"a user-friendly computer system and associated training".* As a matter of fact, some farmers in MOL would also welcome such measures, but they did not see it as crucial for rule compliance at all.

Conclusions from this may be that some basic information, distributed in a way that farmers can easily work with it, is absolutely necessary for giving the farmers a chance to comply with the regulation. Again, the necessary amount of information depends on other factors of the region like the farm sizes and the education, financial incentives and overall motivation of the farmers in the region. In MOL some brochures, summing up the relevant information were already sufficient for the farmers' information about the basic requirements of the regulations and to help complying with most of them. In another region, with smaller farms and/or less educated and motivated farmers more information and training may be necessary. But obviously the CAP sanctioning also played a big role in motivating farmers to inform themselves. In every case, giving enough information about the regulations of a policy in a way appropriate for the regional farmers is a factor determining transaction costs of farmers and thus influencing their cost-benefit relation for compliance. The farmers' transaction costs in this case also depend a lot on how much regulations change and on how complex the overall farming regulations are.

[14] As a matter of fact, in Germany there are lighter rules for certain small and extensive farms, but they only applies to very small side-line farms.

4.2.1.7 Transaction costs from burden of proof

Farmers are not just required to comply with rules for fertiliser planning, they also have to do this in a specific manner and keep proof of their actual compliance. This involves making the records in a specific way and having proofs like contracts. This was perceived as significant additional effort by some farmers. Just as above, the transaction costs here were perceived as being rather low by the employed managers of the large farms in contrast to self-employed farmers of smaller farms for whom these transactions costs were higher opportunity costs.

The determinants of this correspond to those of fertiliser planning in section 4.2.1.3 and information costs in section 4.2.1.6.

4.2.1.8 Benefits of Compliance

In terms of a cost-benefit analysis, the avoided sanctions are benefits of compliance. However, *real* benefits can also be identified. A small number of farmers actually mentioned that the supportive material given to them by the agency helped them in their fertiliser planning and thus in avoiding transaction costs for the calculation and opportunity costs in terms of wrong fertilisation. This refers especially to the reference values (LVLF 2008b). For example there are tables on how much N and other nutrients are included in manure from specific animals, or in specific crops, under certain circumstances in a given year.

This was however only a very small benefit compared to the higher costs.

Also, the investment support for storage facilities could be seen as benefits. As those farmers who had done this investment often said they would have done it anyways because it is part of their production system, they would really benefit from this policy, not just being compensated. But then naturally a question is whether this support actually has an impact on implementation when other farmers say that even with this support they could not afford the modernisation or enlargement of facilities. Still it can be assumed that there are farmers for whom this support makes the crucial difference.

4.2.1.9 Summary of cost-benefit analysis and CIA

In the preceding analysis, different components of an economic approach to compliance and their determinants were regarded. It could be seen that even if farmers in Märkisch-Oderland were making all their decisions based on a purely economic rationality, they would, other than farmers in some other regions, indeed still have complied with many of the requirements, especially concerning fertiliser planning and fertiliser amounts. But other important components of the Nitrates Directive like storage and fertiliser application before the winter posed actual costs for the farmers, partially even when taking avoided

sanctions into account as “benefit”. In those cases there were some examples where farmers actually admitted or implied that they were cheating to some degree. Several determinants of how the bounded economic rationality is applied have been identified in contrast to certain other regions. They have been summed up in table 2 together with the determinants of social rationality, and their overall usability for an ex-ante assessment which is also discussed in 4.3.
However, it seems that a lot of times these requirements, where compliance is costly, are still met to a large degree, which is why this share of compliance will be looked at in the next sections of social rationality.

4.2.2 Social rationality determinants

In the following sections the determinants of the application of reciprocal and normative rationality will be discussed. This will contrary to the economic rationality not be structured according to the single rules because they are more general. Inversely, the discussion will be structured according to the determinants themselves. As said before, reciprocal and normative rationality have some naturally given overlapping. Also, instrumental and social reciprocity will be discussed together because in practice they lie so close together.

4.2.2.1 Reputation and ‘What other people think’

This issue is subsumed under reciprocal rationality here, because it is based on the logic of “If I behave in a certain way, the others will treat me in a corresponding way”. There will not be a psychological analysis about this here, but the practical application in the case study. Farmers were asked how important it is to them, what other people think about their farming practices, and whose opinion was important, to find out how much this issue may influence their behaviour beyond economic rationality. This may be in a social or normative sense or just personally psychological. But it turned out to have mostly instrumental meaning.
In general, 14 out of 16 interviewees who answered these questions, found it important or very important what other people think, but for most only the opinion of people of certain groups played a role.
Most important to the farmers was what their lessors think, and to some degree the neighbours because they could talk to their lessors. They said if the lessor thinks that they manage the land badly, they may not lease it to them anymore, or they will be in a less favourable negotiation position. This naturally accounts especially for practices which damage the soil, but may also count for the general impression of whether the farming company is *“decent”*.

Also important were the employees, because the farmers wanted to be respected by those so that they could work well with them.
Furthermore, for some farmers the society as a whole is important in an instrumental sense because farmers want people to have a positive image of German agriculture in terms of marketing. One farmer also named, more directly, the clients.
The agricultural agency was also named because it is easier to deal with them if they have a good image of the farm. The fitting example was named in section 4.2.1.1.1 before, where buffer zones between fields and water bodies were installed, among others to leave a good impression with inspectors and thus to have easier controls.
However, there were also several farmers who found it important as a value in itself that people in general respect them as a good farmer, be it the neighbours, the family, or the society in general.
Few farmers said that they simply do not care at all.
It seems that reputation does play a serious role for compliance, but mainly for visible behaviour, as it is mostly in an instrumental way about what other people think. In this sense also, BRATT (1999) found out that social norms ("what other people think") do not have a direct influence on environmental behaviour. Only if people care about what others think in a more personal normative way, only as a by-product of what they think is right themselves (personal norms), then this would also be conducive for less visible behaviour.
There is an example of a survey on determinants of compliance with rules about agricultural chemicals in the Netherlands, where ELFFERS ET AL. (2003: 427 et sqq.) found that the approval or disapproval of other farmers was actually crucial for farmers' behaviour. Looking for determinants of when this approval plays a role, it seems logical that the appreciation of the family, and possibly also of neighbouring farmers, may play a much bigger role in small family farms. This is supported by the fact that, in the Netherlands where normative reputation played a bigger role, farm structure is significantly dominated by small family farms[15] (ibid.: 413).
If reputation plays a role for compliance, naturally, it is important what the respective persons important to farmers assume is good agricultural practice.
It would certainly have to be assessed qualitatively whether in a region reputation plays a role for compliance, and in what precise way. Since it is always economically rational to have a good reputation with cooperation partners or clients, it might be more effective to assess the overall environmental attitudes of those groups right away. As this may still be a rather big effort, this aspect may just be acknowledged by assessing the overall

[15] *"Dutch farming is to an overwhelming extent a business of single proprietors/family business, and large scale farming corporations are almost absent. Almost 90 % of all labor on Dutch farms is provided by the owner and his family (Statistics Netherlands, 2000)."* (in ELFFERS ET AL. 2003: 413).

environmental attitudes of the population of the region or even a wider unit of the society, depending on where the agricultural produce is sold. AMBLARD ET AL. (2008), for example, have used the votes for the Green Party and different expenditures of environmental agencies as indicators for the public concern about water pollution in their PICA test regions.

4.2.2.2 Procedural justice, legitimacy and obligation

As explained in 2.8.2.1 as part of reciprocal rationality, procedural justice is the key to the perception of legitimacy, which again is a key to feeling obliged to follow rules.

Procedural justice and legitimacy were addressed on the levels of local authorities regarding controls and general relationship with the local, mostly agricultural, authorities, and the political level regarding the policy-making process and the legitimacy of the policy itself.

4.2.2.2.1 Local authorities

Almost all of the farmers thought that the controls were in general legitimate because they said if a law is adopted it has to be controlled as well because there are always *"black sheep"*, and those should be caught (while obviously some bending of the rules was not considered to make up for being a black sheep). One farmer said that controls are always as legitimate as the law which they are based on. A few farmers, however, felt rather annoyed with the number of controls. These were managers of large farms which had several controls each year (not each for the Nitrates Directive). They were partially really angry because they said that they had really good farming practices compared to many other farms and that it was unfair that they were inconvenienced with these controls so much more often than those others just because of the size of their company.

In general there was some concern whether farmers in other countries would be monitored as closely and the notion of unfair treatment was present.

Practically they all disliked the process of being controlled because of timely opportunity costs and because of the unpleasantness of being controlled at all. However most felt that inspectors just did their job and were respectful. Only few have had really bad experiences with inspectors whom they perceived to be incompetent, had no understanding of practical agriculture and treated the farmers like "*stupid boys"* (*"dumme Jungs"*).

The relationship with the local agricultural agency however, was considered by all but one farmer to be good or very good. The interviewed farmers emphasised frequently that the agents were competent, respectful and allowed for a good cooperation. Farmers receive help with questions like applications for direct payments. Agents understand practical

agriculture, so that *"sensible solutions are found"* if a farmer has a problem[16] and there is no arbitrary treatment of the farmers. The cooperative nature of the relationship was emphasised by those farmers who take part in a scheme in which they give data to the agency about their production, for example what crop yields they had.

Most farmers had less to say about the local environmental agency. Those who did have contact partially said that the relationship is okay, while others said there were some really incompetent agents who do not understand agriculture at all.

The possibilities to assess whether the experience with inspectors and local agents actually influences compliance behaviour were very limited in this research. Combined with evidence of other studies, some suggestions can be made, though. TYLER (1999) found out that the perception of procedural justice, and via this legitimacy, of authorities like police and judges plays a role in compliance of the law in everyday life. Closer to this research here, WINTER AND MAY (2001) found out that Danish farmers' compliance with nitrate related rules depends, among others, on the behaviour of inspectors. In MOL, directly asked about the relevance of their relationship with the local agency for their motivation to comply with farming rules, many farmers said that there was no connection. However they might simply not be aware of this influence (see 2.8.2). Few said there may be some indirect connection because a good relationship with the agency is very useful for them, and this way, they want the local authorities to at least have a good picture of them. And since all the farmers (but one) praised the good relationship with the agency, it can be assumed, that for them too, it does play a role, at least in this instrumental way. Also, there was a lot of emotion concerning issues of legitimacy of controls and arbitrariness of local agents (the latter was named less because they mostly perceived procedural fairness and not arbitrariness) which suggests that there is an influence of this legitimacy perception on behaviour. This is naturally not hard evidence but just leads to the corroborated hypothesis that procedural justice and legitimacy play a role in farmers' compliance.

It should be added that without having been addressed explicitly, in this context, trust seems to play a crucial role here because farmers have an incentive to comply with the rules if they can trust in the authorities' appropriate reactions.

Certainly, perceptions of procedural justice, legitimacy, and the relationships with local agencies have to be assessed with a survey or expert interviews and not with given statistical data.

[16] This might naturally be a hint to a bias of the agricultural agency, but it is not within the focus of this research to be assessed here.

4.2.2.2.2 Legitimacy of the policy measures and political processes

On a political level the following issues were addressed, concerning procedural justice and legitimacy: The relevance of the measures, the political process in which they were decided upon, and the fairness of the measures.

All farmers saw at least some relevance in the measures. Some farmers actually thought that they were all in all useful; some thought that the general idea to reduce nitrates in the waters was important but the measures themselves deficient.

The opinions about the legitimacy of the political process were also very ambiguous. There was a relatively even distribution between finding the political process in which Nitrates Directive measures were decided *"little legitimate"* and *"largely legitimate"* with a tendency to *"largely legitimate"*, while one farmer chose *"absolutely not legitimate"*. In general, farmers thought that measures were chosen with too little consultation of farmers and thus too far away from agricultural reality.

Farmers were asked whether they perceived complying with farming practice rules like those Nitrates Directive rules in general as an exchange with society in the sense that they get support, namely direct payments, and therefore put up with restrictions. There were also much differentiated opinions on this, with a relatively even distribution between absolute agreement and absolute disagreement. This obviously has to do with the history of the direct payments, which in their origin were intended for food security for European citizens and the competitiveness of European agriculture, not to compensate for restrictions in farming practices. The important point however is that those disagreeing mostly did not argue that they needed more or different compensation for following the rules, but rather argued that following most of the Nitrates Directive rules should be self-evident as being part of this society, that it is part of the professional honour, or simply that rules have to be complied with because of otherwise occurring sanctions.

It was also mentioned as an important point that farmers doubted the compliance of farmers in other countries which some were discontented about. However those who mentioned this point also said that in the end somebody has to start and that they appreciate and support Germany, in their eyes, being a forerunner on environmental issues.

It could be seen that overall there is quite some critique about political legitimacy of the rules. What was crucial is obviously more that a general relevance of the rules was acknowledged. This also showed in that it seemed that farmers bend the rules at points where they think that they are not really relevant, for example, when they think certain aspects of manure application have been made for regions with more rain.

The aspect of feeling treated unfairly as compared to farmers elsewhere played a minor role here, as said because it was compensated by a certain pride in taking part in a leading role – but also because in Germany all farmers have to comply with these rules.
In other studies, this was different. In some NVZ in Scotland where compliance was less than in MOL, farmers felt treated very unfair compared to farmers out of the NVZ (BARNES ET AL. 2008). Also, in the PICA study region in the French Midi-Pyrenees, farmers felt unfairly judged by society for pollution and partially acted on it with non-compliance (LEMEILLEUR 2008). From this perspective, declaring the whole German territory as NVZ was maybe very useful for acceptance of the rules; even though some farmers in MOL did complain about the lacking regional adaptation of the rules but that was a minor issue.
Additionally, farmers in the Midi-Pyrenees also felt unlegitimately inconvenienced with the controls and with too complex rules. They *"fear control (even [..] farmers who apply good practices) because they are never sure that they exactly comply with the law"* (LEMEILLEUR 2008). Rather than in the German case where some farmers try to make up for this complexity by trying to make their farming practices look as correct as possible. those French farmers reacted on this, and their aforementioned critical points, rather with open non-compliance as a means of protest against these circumstances (LEMEILLEUR 2008). In this case farmers obviously act upon social rationality since their costs for protest non-compliance was higher than for compliance (ibid.). The crucial difference here seems to be, on the one hand, the size of farms and connected height of sanctions, because farms in the PICA test departments are on average between 47 and 56 ha, and fines are perceived as rather low. On the other hand, there is certainly also a cultural difference in terms of how farmers react on critical policy measures.
For an assessment, in some cases a review of locally spread agricultural press may give quick insights into perceptions of legitimacy and relevance of policy measures. These may actually also play a role in legitimising a policy in the first place (see next section). This naturally is only possible if the policy option is already publicly discussed which may not be very likely at the time where an ex-ante assessment is commissioned. Then, a survey or expert interviews would probably be necessary.

4.2.2.3 Internal environmental norms

In the above sections compliance with the rules was regarded, not only, but more from a social norms perspective, that is what do other people, i.e. the society, the neighbours, the authorities, the lawmaker, think has to be done. This section rather has a focus on internalised norms, that is, what the farmers think themselves is right. But again there is necessarily some overlapping.

Farmers were asked how they weigh environmental factors in relation to economic factors in their production. Most farmers said that protecting the environment and having an economically efficient production was as important to them. Only one farmer said that environmental protection weighs a bit more. Three farmers said conversely that economy was a bit more important, even if the environment sometimes has to suffer for this. Many emphasised that first you need to keep your company alive before you can protect anything. Several times it was said *"a sensible compromise between both has to be found"*. Also few farmers refused to answer the question because they claimed there was usually no contradiction between the environment and economics.

Some more concrete examples shed more light on this.

Regarding the Nitrates Directive rules, trade-offs between economics and environment for the farmers usually occur concerning manure storage and fertiliser application. For example, some farmers were aware of the environmental relevance of the storage facilities but said that it was just too costly to modernise or enlarge them. Spreading more than the allowed amount of fertiliser before the winter was done by several farmers without being aware that this was not allowed because, they said, in the spring the soil is too wet to spread the fertiliser. Here possibly, already more information on catch crops could be helpful.

Other issues which pose some opportunity costs to farmers concern the application of manure, especially in a certain distance from water bodies, and inappropriate disposing of slurry, as discussed in the economic rationality part. In these questions the tenor tendency was that these issues, to a certain degree, are self-evident to farmers now, and part of a kind of *"good"* or *"decent behaviour",* as some farmers put it.

In this sense, those rules have been internalised, as they are followed because of the conviction that it is the right thing to do, not just because of being threatened with sanctions. Obviously, the costs for these restrictions are not as high as the ones for storage facilities and this way cannot be compared to those. But one farmer also brought up the example that what he would really never do is dumping slurry in a ditch or similarly inappropriate place which would be a partial solution to the storage problem.

Quite in general, several farmers said that it was absolutely important to them to farm sustainably so as to leave the natural resources in good condition to coming generations. At that point, obviously, there can be a discrepancy between what a farmer perceives of as leaving the resources in good condition and what, for example, environmental scientists think about this. When farmers were illustrating what they meant by that, usually they talked mainly about soil and the landscape, but not about water or let alone air and climate.

Similarly, being asked about feeling obliged to follow environmental rules, several farmers said, in addition to "feeling obliged" because they would risk sanctions otherwise, they felt obliged when they thought that the rules at least made some sense. (This naturally is in addition to other reasons of obligation like legitimacy, which were discussed in the above sections). In this context, again, awareness and perception of what is environmentally relevant is vital for compliance. WINTER AND MAY (2002) found that in the similar case of Danish farmers' compliance with rules concerning fertilisation and manure, it is very important from which sources farmers get information. Different sources are trusted more or less in different questions. For example, if representatives of farmers associations would encourage following certain environmental rules, they would be trusted to support only rules which make sense environmentally in a sensible relation to the economy. Contrary, if environmental associations, which are frequently doubted to understand agriculture, promote certain rules, they will be less trusted.

On the whole, what can be seen here for the application of normative rationality is that awareness is an important trigger, but that still the environmental benefit is compared with the costs by the farmers. Only if costs for compliance are really low, or conversely costs for the environment are thought to be very high, the decision on the behaviour will be based on norms for environmental protection, whereas there are further differences as to how environmental and economic costs are weighed. (It should be mentioned that while it is clear that environmental awareness does not necessarily lead to environmentally friendly behaviour, here it is identified as one important prerequisite for norm internalisation.)

For an ex-ante assessment it is then important to ask what factors favour farmers' awareness and appreciation of certain environmental connections which the rules to be implemented are based on, and finally the internalisation of those or some more general environmental rules.

Actually, due to the qualitative character of the research, it is hard to find general correlations for this but some clues can be drawn from the interviews.

It was obvious that for the younger interviewees some environmental issues are much more self-evident than for older interviewees. It became especially obvious when in an interview of the father and the son of a family farm, the father claimed that certain production aspects were not so relevant for the environment but the son contradicted this opinion on the basis of environmental connections he had learned about in university. This way, in an ex-ante assessment, it would first have to be assessed qualitatively whether younger people have learned more things relevant for the rules to be implemented. If so, then statistics about the age of farmers can be used. The same is true for different educational backgrounds.

It seemed also important how much the farmers educate themselves continuingly – this has been discussed already in 4.2.1.3.2. However, concerning the appreciation of environmental norms, it is not just important that farmers keep on learning over the years, but a lot depends on where they get their information from. It seems that in this respect it is rather so that farmers who are already interested in the environment use the respective information and not vice versa.

This way, it could be interesting to look in each region for specific indicators for this awareness. For practical reasons this might be done on a much more general basis. For example it could be an indicator for acting in the logic of environmental norms in general if farmers in the region have organised a GMO-free zone (which could not be used vice versa because MOL is the most important GMO growing part of Germany).

Determinants found in the interviews were much more individual and possibly not accessible for ex-ante assessment in an efficient way. For example, one farmer was also a hunter. He saw for himself that biodiversity was declining, which he was concerned about, and also water quality was important for him as drinking water for the animals. One farmer had acquired a PhD in the field of horticulture and claimed his knowledge about ecological connections to be his most important motivation to act environmentally friendly. Another farmer had a friend who is a bee-keeper who made him more sensitive for paying attention to the impact of his farming practices on factors outside his production system.

Additionally, it was obvious that some people simply have more psychological incentives to so-to-speak “be good persons” by basing their behaviour more on, for example, environmental norms, while others find it more normal to make decisions exclusively upon self-interested analyses of costs and benefits. Whether and how these psychological aspects could be made accessible to an ex-ante assessment is beyond this thesis.

4.2.3 Additional aspects of rationality dynamics

The theoretical framework of rationality dynamics explained in 2.8.3 has led the evaluation of the results in terms of finding determinants of certain behaviours. In this section, a complementation to this shall be made.

An important aspect in the rationality dynamics framework was the issue of the institutional context as trigger of applying certain rationalities. Specifically, the observation of the authors cited in 2.8.3 is that stakeholders already making decisions on the basis of social rationalities may react adversely on a command-and-control policy, and vice versa.

Following this argumentation would mean that in the case of Märkisch-Oderland a command-and-control policy might be less effective than a policy based on voluntary

compliance since farmers tend to find the compliance rather self-evident while being angry about too much monitoring (see 4.2.2.2.1).

On the other hand, several farmers said that the laws, i.e. the DüV and the VAwS, themselves played an important role in raising their awareness of the environmental importance of the addressed issues. Even the sanctions were in a way appreciated so as to force farmers to think about certain issues at all, or in other cases give them incentives to really think them through when they had heard about them before but did not have any incentive to pay real attention to them.

Thus there is then the trade-off between raising awareness through law and sanctioning regime, as well as farmers feeling offended when the rules have already been internalised. This is certainly a relevant issue for policy design. To make it accessible to an ex-ante assessment would probably be a relatively large effort. Yet, it is still a question whether those farmers who feel unfairly monitored are indeed more likely to cheat. As a matter of fact, in this context it seems rather unlikely since if they regard certain rules as the right things to do, and also, if they would still face the possibility of sanctions if they cheated and got caught, they probably do still not have much incentive to cheat. Rather they could have an incentive for protest non-compliance as in the Midi-Pyrenees (see 4.2.2.2.2). Certainly the cultural backgrounds are one reason for these different behaviours but also the farms in the Midi-Pyrenees PICA test regions are much smaller. This again is a hint to that managers of smaller farms will act more upon social rationality than managers of larger farms because they have more freedom in how to act.

4.3 Reflections on relevance for ex-ante assessments

In the preceding chapters, aspects of farmers' compliance with the Nitrates Directive have been analysed. The relevance for ex-ante assessments has been considered along the analysis but some crucial insights shall be summed up, reflected and complemented here.

A full overview of all of the identified determinants, together with a short description of their potential influences and consequences for ex-ante assessment is presented in the table "Overview of aspects and indicators" which can be found in the annex 1.

Generally, in the analysis no strict distinction between aspects to be assessed in an ex-ante assessment, and indicators for those aspects has been made due to the more general analysis of determinants. Some of the identified determinants rather have the character of aspects in the sense of CIA in PICA (e.g. transaction costs), some rather have the character of indicators (e.g. farm sizes for transaction costs), and some can be seen as both (e.g. available information).

Some determinants have been identified which are indicators for several aspects, where they may have controversial meanings. An important example is *agricultural structure – farm sizes* which has been found to have influence on eight different aspects of compliance with the Nitrates Directive. Some examples are: on the one hand, if a region is characterised by a lot of large farms, with the same number of controls, more farms can be monitored than in a region with many small farms. On the other hand, on large farms it is usually easier to hide non-compliance. Also, large farms usually have specialised personal who more effectively deal with information gathering and planning. But family farmers are more likely to act upon social rationality like having the approval of their peers and family.

The latter aspect is a good example for a determinant which could not be used right away in an impact assessment, but the direction and intensity of influence would have to be assessed first. In this example, to use farm sizes as indicator for farmers' inclination to act upon social rationality would prior to that need an assessment of what attitude peers and family have, that is, whether their influence would actually go into the direction of the policy goals. Vice versa, the determinant *environmental attitudes of other social groups* is only useful to assess if prior to this the influences of the relevant social groups have been assessed.

Some aspects have to be used with special care because of their influence on rationality dynamics. For example, a high number of controls can be very useful when many farmers show opportunistic behaviour. However, if most farmers already act environmentally friendly for social reasons, a high number of controls may trigger a change to economic rationality and thus, if compliance is costly, to non-compliance.

Another issue to mention are thresholds, which may be different in different regions. For example, it was obvious that education played a role for compliance. One might assume that a crucial difference is between farmers with a university or similar degree and farmers without. However, this difference seemed to have only little significance. The crucial significance was between farmers who have had an agricultural education at all (in Germany at least "Geselle", see glossary) and those who did not. In other regions this threshold may be a different one in dependence of, for example, farm sizes and habits of ongoing education.

Vice versa, the educational level of farmers can have an influence on the thresholds of the impact of farm sizes, which shows also that these determinants are interdependent, which has to be considered in an ex-ante assessment.

Naturally, some of the determinants found are very specific to the implementation of the Nitrates Directive like the share of animal production in the region's agricultural sector. But most aspects have a more general meaning and can be applicable in many agri-environmental policies, especially command-and-control policies. This refers to the cost determinants in general. Some cost determinants are very specific here, like prices for storage facilities. They can, however, easily be transferred to other policies. Other costs have a more general meaning right away, like information costs. The social determinants were even more general for agri-environmental policies, most being not even constrained to command-and-control policies, like the environmental norms internalised by farmers.

Finally, in the analysis a lot of determinants were identified which would have to be assessed with surveys or qualitative interviews. For each of these aspects it would have to be considered whether it is important enough in the specific assessment. Especially, for some aspects, several factors play a role, and it may be enough to assess only part of these aspects.

5. Conclusions

In this research I analysed determinants of farmers' compliance in the case study region Märkisch-Oderland. This was not done as an assessment of compliance but as a way to gather information on determinants and connections between them in consideration of their potential use in ex-ante assessments of the institutional compatibility of agri-environmental policy options with specific regions.

Starting out, the Procedure of Institutional Compatibility Assessment helped to explore the main aspects of policy implementation in the region by structuring the analysis of the pre-study and offering access to compiled results of former literature reviews.

Focusing on the decision-making of the farmers, the main analysis was facilitated by a framework of plural rationalities and included semi-structured interviews besides literature and document evaluation. Applying the framework helped to structure the analysis but also to discover and explain certain connections between determinants. Especially since focusing on compliance behaviour the framework had much to offer because it helps identify what aspects actors consider in which way for making their decisions on compliance behaviour. It had to be recognised that the analysis of social rationalities applied by the farmers was difficult by means of qualitative interviews alone, without the possibility for quantitative correlations or even experiments. However, within the given timely and financial restrictions, the qualitative approach was more effective because the explorative share of the research was still very important, and because the qualitative analysis could be effectively complemented by taking into account results of other studies.

Corresponding to the methodological challenges, for the case study itself it was easier to come to conclusions on economic determinants because they can be retraced more directly and more objectively than social determinants. Yet, together with the information of the literature, some social aspects could be detected as well and named as corroborated hypotheses, which could be investigated further or directly assessed in future projects.

An important reason for the Nitrates Directive rules being relatively well complied with by farmers in the region, is that overall costs concerning most rules are relatively low. However, this is not just determined by absolute costs but also by how farmers perceive the costs. Because of incomplete information other fertilisation strategies than are advocated in the Nitrates Directive could be preferred. One crucial determinant for this compatibility of the policy measures with the regional farmers seems to be the sizes of farms. For larger farms it is more efficient to make thorough calculations for fertilisation than for small farms. However, farm size is an indicator for various aspects of this policy implementation and has to be carefully applied in an assessment, just as several other determinants. Together with education it is also an example for the need of regionally

specific assessment of thresholds of indicators and considering interrelationships of the same.

Social and normative aspects which most likely determine farmers' behaviour include the perception that the policy is legitimate, especially in terms of its perceived relevance which itself depends on factors like environmental awareness and quality and availability of information. Those latter factors are also determinants of the farmers' internalisation of environmental norms, which again is conducive for them complying even when compliance is costly and no other instrumental incentive would support compliance.

Most of the identified determinants, which are all summarised in the overview table in annex one, are not constrained to the implementation of the Nitrates Directive but could also be applicable to other regulatory agri-environmental policies.

This way, the results of this research might be useful for future ex-ante assessments or as a starting-point for further investigations, especially in regard to social aspects and the dynamics of the application of different rationalities.

References

AGRARHEUTE. March 4, 2009. Nährstoffversorgung: Hohe Düngerpreise legen den Markt lahm. Online: http://www.agrarheute.com/pflanze/allgemeines/hohe_d%FCngerpreise_legen_markt_lahm.html?redid=290927 (last access 8.3.2009).

AMBLARD, L., AZNAR, O., MANN, C., SCHLEYER, C., THEESFELD, I., AND K. HAGEDORN (2008). *Evaluation and suggestions for improvement of the Procedure for Institutional Compatibility Assessment (PICA) and integration of PICA into the third prototype of SEAMLESS-IF*, PD6.5.5.2, SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, www.SEAMLESS-IP.org.

ATTESLANDER, PETER. 2003. *Methoden der empirischen Sozialforschung.* 10th ed. Berlin: Walter de Gruyter.

BABBIE, E. 2004. *The Practice of Social Research.* 10th ed. Belmont, CA: Wadsworth/ThomsonLearning.

BAHRS, E. AND I. RUST. w.y. *Notwendigkeit und Konsequenzen einer aktualisierten Bodenschätzung in der Landwirtschaft aus betriebswirtschaftlicher Sicht*. Online: https://www.uni-hohenheim.de/i410b/download/gewisola/papers/bahrs.pdf (last access 23.03.09).

BARNES, ANDREW, TOMA, LUISA, HALL, CLARE AND JOYCE WILLOCK. 2007. *Implementing the Action Programme for Nitrate Vulnerable Zones in Scotland: Farming Practices and Awareness*. Edinburgh: Scottish Government Social Research. Online: http://www.scotland.gov.uk/Resource/Doc/208205/0055221.pdf (last access 22.04.09).

BARNES, ANDREW, WILLOCK, JOYCE, HALL, CLARE AND LUISA TOMA. 2008. *Farmer Responses to Nitrate Vulnerable Zone Designation in Scotland.* Paper presented at the 82nd Annual Conference of the Agricultural Economics Society. Royal Agricultural College, 31st March to 2nd April 2008. Online: http://ageconsearch.umn.edu/bitstream/36767/2/Barnes_wilcock_hall_toma.pdf (last access 22.04.09).

BECKER, GARY S. 1968. Crime and Punishment: An Economic Approach. *The Journal of Political Economy* 76(2): 169-217.

BECKER, GARY S. AND KEVIN M. MURPHY. 2000. *Social economics: market behaviour in a social environment*. Cambridge and London: The Belknap Press of Harvard University Press.

BICCHIERI, CHRISTINA. 2000. Words and Deeds: A Focus Theory of Norms. In: NIDA-RÜMELIN, JULIAN AND WOLFGANG SPOHN. *Rationality, Rules and Structure*. Dordrecht: Kluwer Academic Publishers, pp. 153-184.

BMELV – Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz. 2008. *Landwirtschaftliche Betriebe und ihre Flächen nach Größenklassen*. Online: http://www.bmelv-statistik.de/de/agrarbericht-daten-und-fakten/ausgewaehlte-daten-und-fakten-der-agrarwirtschaft/ (last access 22.04.09).

BMU - Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit. 2004. *Bericht der Bundesrepublik Deutschland gemäß Artikel 10 der Richtlinie 91/676/EWG des Rates vom 12. Dezember 1991 zum Schutz der Gewässer vor Verunreinigungen durch Nitrat aus landwirtschaftlichen Quellen*. Online: http://www.bmu.de/files/pdfs/allgemein/application/pdf/nitratbericht_2004.pdf (last access 22.04.09).

BOLAN, RICHARD S. 1999. Rationality revisited: An alternative perspective on reason in management and planning. *Journal of Management History* 5(2): 68 – 86.

BRATT, CHRISTOPHER. 1999. The Impact of Norms and Assumed Consequences on Recycling Behavior. *Environment and Behavior* 3(5): 630-656.

BROUWER, FLOOR, HEINZ, INGO AND THOMAS ZABEL. 2003. *Governance of Water-related Conflicts in Agriculture*. Dordrecht, Boston, London: Kluwer Academic Publishers.

BUND - Bund für Umwelt und Naturschutz Deutschland e.V. 2007. *Grundwasser: Guter Zustand bis 2015!*. Berlin: Natur und Umwelt.

CONRAD, JOBST. 1992. *Nitratpolitik im internationalen Vergleich*. Berlin: Edition Sigma.

DABBERT, STEPHAN AND JÜRGEN BRAUN.2006. *Landwirtschaftliche Betriebslehre*. Jena: UTB.

DBV - Deutscher Bauernverband. November 25, 2005. *Nationale Alleingänge bei der Düngung müssen verhindert werden Bundesratsbeschluss zur Düngeverordnung weist Licht und Schatten auf*. Press release. Online: http://www.bauernverband.de/index.php?redid=158580 (last access 22.04.09).

DüV – Düngeverordnung. Verordnung über die Anwendung von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln nach den Grundsätzen der guten fachlichen Praxis beim Düngen in der Fassung der Bekanntmachung vom 27. Februar 2007 (BGBl. I S. 221).

ECKERT, HANS, BREITSCHUH, GERHARD, AND DIETER R. SAUERBECK. 2000. Criteria and standards for sustainable agriculture. *Journal of Plant Nutrition and Soil Science* 163: 337-351.

ELFFERS, HENK, VAN DER HEIJDEN, PETER AND MERLIJN HEZEMANS. 2003. Explaining Regulatory Non-compliance: A Survey Study of Rule Transgression for Two Dutch Instrumental Laws, Applying the Randomized Response Method. *Journal of Quantitative Criminology* 19(4): 409-439.

EWERS, HANS-JÜRGEN AND WILHELM HENRICHSMEYER (eds.). 2000. *Agrarumweltpolitik nach dem Subsidiaritätsprinzip*. Denkschrift des Schwäbisch Haller Agrarkolloquiums der Robert Bosch Stiftung. Berlin: Analytica.

FURUBOTN, EIRIK G. AND RUDOLF RICHTER. 2000. *Institutions and Economic Theory: The Contribution of the New Institutional Economics.* Ann Arbor: The University of Michigan Press.

HAAKH, FRIEDER. 2006. Anforderungen an den Gewässerschutz aus Sicht der Wasserversorgung. *Gas- und Wasserfach. Wasser Abwasser* 147(13): 37-44.

HAGEDORN, K., ARZT, A., AND U. PETERS. 2002. Institutional Arrangements for Environmental Cooperatives: a Conceptual Framework. In: HAGEDORN, K. (ed.). *Environmental Co-operation and Institutional Change: Theories and Policies for European Agriculture*. Cheltenham: Edward Elgar.

HAGEDORN, KONRAD 2008. Particular requirements for institutional analysis in nature-related sectors. *European Review of Agricultural Economics* 35(3): 357–384.

HARLAND, PAUL, STAATS, HENK AND HENK A. M. WILKE. 1999. Explaining Proenvironmental Intention and Behavior by Personal Norms and the Theory of Planned Behavior. *Journal of Applied Social Psychology* 29(12): 2505-2528.

HEUTE IM BUNDESTAG. December 8, 2004. Liberale fordern praktikable Novelle zur Düngeverordnung. Online: http://www.bundestag.de/aktuell/hib/2004/2004_304/02.html (last access 22.04.09).

HIRSCHAUER, NORBERT AND ALBERT GIEREND. 1998. Entscheidungsunterstützung durch Risikosimulationen. *Neue Landwirtschaft* 7/98: 14-19.

ISIN, SULE, AND ISMET YILDIRIM. 2007. Fruit-growers' perceptions on the harmful effects of pesticides and their reflection on practices: The case of Kemalpasa, Turkey. *Crop Protection* 26: 917–922.

KASTENS, BRITTA AND JENS NEWIG. 2007. The Water Framework Directive and Agricultural Nitrate Pollution: Will Great Expectations in Brussels be Dashed in Lower Saxony? *European Environment* 17:231–246.

KERSEBAUM, KURT CHRISTIAN, MATZDORF, BETTINA, KIESEL, JOACHIM, PIORR, ANNETTE AND JÖRG STEIDL. 2006. Model-based evaluation of agri-environmental measures in the Federal State of Brandenburg (Germany) concerning N pollution of groundwater and surface water. *Journal of Plant Nutrition and Soil Science* 169: 352–359.

LAND UND FORST. August 29, 2004. Eins-zu-eins-Umsetzung der EU-Nitratrichtlinie gefordert. Online: http://www.landundforst.de/index.php?redid=78759 (last access 22.04.09).

LEMEILLEUR, SYLVAINE (2008, September). *PICA testing Midi-Pyrenees Report*. Unpublished report within the SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, www.SEAMLESS-IP.org.

LLFG – Landesanstalt für Landwirtschaft, Forsten und Gartenbau Sachsen-Anhalt. 2007. Nährstoffvergleichsrechner. Online: http://www.sachsen-anhalt.de/LPSA/index.php?id=28125 (last access 22.04.09).

LUA - Landesumweltamt Brandenburg. 2007. *Bericht zur Grundwasserbeschaffenheit im Land Brandenburg für den Zeitraum 2001 bis 2005*. Studien und Tagungsberichte Band 55. Potsdam: LUA.

LUA EXPERTS. 2008. Anonymous experts of Landesumweltamt Brandenburg interviewed by author. Potsdam, May 2008.

LVLF - Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung Brandenburg. 2008a. *Jahresbericht 2007 Landwirtschaft und Gartenbau*. Potsdam: MLUV.

LVLF - Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung Brandenburg. 2008b. *Richtwerte für die Untersuchung und Beratung sowie zur fachlichen Umsetzung der Düngeverordnung (DüV)*. Potsdam: LVLF.

LVLF - Landesamt für Verbraucherschutz, Landwirtschaft und Flurneuordnung Brandenburg. 2007. *Gemeinsame Hinweise der Länder Brandenburg, Mecklenburg-Vorpommern und Sachsen-Anhalt zur Umsetzung der novellierten Düngeverordnung.* Potsdam: Land Brandenburg.

MACGREGOR, COLIN J., AND CHARLES R. WARREN. 2006. Adopting sustainable farm management practices within a Nitrate Vulnerable Zone in Scotland: The view from the farm. *Agriculture, Ecosystems and Environment* 113: 108–119.

MAYRING, PHILIPP. 2000. Qualitative Content Analysis. *Forum Qualitative Social Research* 1(2). Online: http://www.qualitative-research.net/index.php/fqs/article/view/1089/2384 (last access 22.04.09).

MLUR - Ministerium für Landwirtschaft, Umweltschutz und Raumordnung des Landes Brandenburg. 2000. *Rahmenempfehlungen zur Düngung 2000 im Land Brandenburg*. Potsdam: MLUR.

MLUV - Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg. w. y. *Auflistung der 100 Betriebe, die den größten Betrag an*

Fördermitteln erhalten haben. Online: http://listi.jpberlin.de/pipermail/genug-ist-genug/attachments/20071123/3c8b5780/attachment.pdf (last access 22.04.09).

MLUV - Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg. 2007. *Informationsbroschüre für die Empfänger von Direktzahlungen über die anderweitigen Verpflichtungen (Cross Compliance)*. Potsdam: MLUV.

MLUV - Ministerium für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg and Stiftung NaturSchutzFonds Brandenburg. 2005. *Steckbriefe Brandenburger Böden*. Potsdam: MLUV Brandenburg und NaturSchutzFonds Brandenburg.

MOL - Amt für Statistik Berlin-Brandenburg, Landkreis Märkisch-Oderland, Statistische Erhebungsstelle. 2008. Data sheets on farm structure in Märkisch-Oderland 1999 until 2007. Received by email in May 2008.

MOL EXPERT. 2008. Anonymous expert of Landwirtschaftsamt Märkisch-Oderland (local agricultural agency) interviewed by author. Seelow, May 2008.

MÜLLER, LOTHAR. w.y. *Das Oderbruch und die Flußaue der Oder*. Müncheberg: Institut für Bodenlandschaftsforschung im ZALF. Online: http://www.zalf.de/home_zalf/institute/blf/blf_e/mitarbeiter/mueller/pdf/exkurs.pdf (last access 22.04.09).

NIDA-RÜMELIN, JULIAN (2000). Rationality: Coherence and Structure. In: NIDA-RÜMELIN, JULIAN AND WOLFGANG SPOHN. *Rationality, Rules and Structure*. Dordrecht: Kluwer Academic Publishers, pp. 1-16.

NIELSEN, JESPER RAAKJÆR. 2003. An analytical framework for studying compliance and legitimacy in fisheries management. *Marine Policy* 27: 425–432.

NITRATES DIRECTIVE. European Council Directive of 12 December 1991 concerning the protection of waters against pollution by nitrates from agricultural sources. (91/676/EEC). Official Journal L375, 31/12/1991, 0001-0008.

NORTH, D.C. 1991. Institutions. *Journal of Economic Perspectives* 5(1): 97-112.

PRAZNAN, JAROSLAV. 2009. Talk at the SEAMLESS training course in Nové Hrady, Czech Republic, 2.-6. February 2009; confirmed by email-contact in April 09.

PUNCH, KEITH F. 2005. *Introduction to Social Research: Quantitative and Qualitative Approaches.* London: Sage.

SCHLEYER, C., THEESFELD, I., HAGEDORN, K., AMBLARD, L., AZNAR, O., AND C. MANN. 2007b. *First evaluation and suggestion for improvement of the Procedure for Institutional Compatibility Assessment (PICA) and suggestions for its integration into the third prototype of SEAMLESS-IF*, PD6.5.5.1, SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, www.SEAMLESS-IP.org.

SCHLEYER. CHRISTIAN, THEESFELD, INSA, HAGEDORN, KONRAD, AZNAR, OLIVIER, CALLOIS, J.M. ET AL., 2007a. *Approach towards an operational tool to apply institutional analysis for the assessment of policy feasibility within SEAMLESS-IF*, D2.4.2, SEAMLESS integrated project, EU. SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, www.SEAMLESS-IP.org.

SCOTTISH EXECUTIVE ENVIRONMENT GROUP. 2003. *Guidelines for farmers in nitrate vulnerable zones*. With letter to all occupiers of NVZ in Scotland. Online: http://www.scotland.gov.uk/Resource/Doc/47074/0017579.pdf (last access 22.04.09).

SCOTTISH EXECUTIVE. 2005. *Cross Compliance Notes for Guidance*. Online: http://www.scotland.gov.uk/Resource/Doc/47121/0020538.pdf (last access 22.04.09).

SCOTTISH GOVERNMENT ENVIRONMENTAL QUALITY DIRECTORATE. 2007. *Protection of Scotland's Water: Environment Action Programme for Nitrate Vulnerable Zones: Proposed Amendments. Analysis of consultation responses received*. Edinburgh: The Scottish Government. Online: http://www.scotland.gov.uk/Resource/Doc/197124/0052744.pdf (last access 22.04.09).

SEN, AMARTYA K. 1977. Rational Fools: A Critique of the Behavioral Foundations of Economic Theory. *Philosophy and Public Affairs* 6(4): 317-344.

STMLF - Bayerisches Staatsministerium für Landwirtschaft und Forsten. 2008. *Bayerischer Agrarbericht 2008*. München: StMLF.

THEESFELD, I., SCHLEYER, C., CALLOIS, J., AND O. AZNAR. 2008. Ex-Ante Policy Assessment from an Institutional Perspective: A Procedure for Institutional Compatibility Assessment (Pica). *ICAR Discussion Paper* 20/2008.

TYLER, TOM R. 1999. *Why People Obey the Law*. New Haven: Yale University Press.

VAN ITTERSUM, MARTIN. 2009. Presentation at the SEAMLESS training course in Nové Hrady, Czech Republic, 2.-6. February 2009.

VATN, ARILD. 2005a. *Institutions and the Environment*. Cheltenham: Edward Elgar.

VATN, ARILD. 2005b. Rationality, institutions and environmental policy. *Ecological Economics* 55: 203– 217.

VAWS – Anlagenverodnung. Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen und über Fachbetriebe vom 18. Januar 2006. Geändert durch Verordnung vom 15. Februar 2008, geändert durch Verordnung vom 30. September 2008 (Inkrafttreten am 1. November 2008). (GVBl Nr. 2/2006, S. 63, GVBl Nr. 4/2008, S. 65, und Nr. 22/2008, S. 830).

VOSS, THOMAS 2000. The Realization of Social Norms among Rational Actors. In: NIDA-RÜMELIN, JULIAN AND WOLFGANG SPOHN. *Rationality, Rules and Structure*. Dordrecht: Kluwer Academic Publishers, pp. 49-66.

WENZEL, MICHAEL. 2004. The Social Side of Sanctions: Personal and Social Norms as Moderators of Deterrence. *Law and Human Behavior* 28(5): 547-567.

WINTER, SØREN C. AND PETER J. MAY. 2001. Motivations for Compliance with Environmental Regulations. *Journal of Policy Analysis and Management* 20(4): 675–698.

WINTER, SØREN C. AND PETER J. MAY. 2002. Information, Interests, and Environmental Regulation. *Journal of Comparative Policy Analysis: Research and Practice* 4: 115–142.

WOIDKE, DIETMAR, Minister für Ländliche Entwicklung, Umwelt und Verbraucherschutz des Landes Brandenburg. 2008. Statement zum Besuch der Agrarkommissarin Fischer-Boel in der Agrargenossenschaft Mittenwalde am 20.01.2008. Online: http://www.mluv.brandenburg.de/cms/detail.php/bb2.c.449107.de (last access 22.04.09).

ZINTL, REINHARD. 2000. Constitutions as External Constraints? In: NIDA-RÜMELIN, JULIAN AND WOLFGANG SPOHN. *Rationality, Rules and Structure*. Dordrecht: Kluwer Academic Publishers, pp. 35-48.

Annex 1: Overview of aspects and indicators

Explanations:

- Determinants can be seen in an assessment as crucial aspects or as indicators; some could be seen as both. Here, aspects are shown in **bold** letters, only-indicators in normal letters.
- Due to multiple linkages determinants are only loosely sorted by topic
- Reference to other determinants are shown by putting these determinants in single quotation marks as in: '...'
- The determinants are described in regard to agri-environmental command-and-control policies but also specific aspects for the Nitrates Directive (ND) implementation are named

Determinants (aspects and indicators)	**Specific influence**	**Consequence for assessment**	**Discussed in section:**
Additional production costs (perceived and actual)	Determine costs of compliance	Survey/interviews/calculation; Policy specific indicators	4.2.1.2+3
Storage capacities	a) Possibility to wait with manure application for best conditions b) ND requirement itself; high costs → may lead to opportunistic behaviour	Specific indicator for CBA in case study	4.2.1.4
Cooperation potential	a) Cooperation needed for exchange between animal production and arable farms b) Possibly for innovation adoption but not in the case study See also 'trust'	Diverse meaning for different policies, accordingly different assessments	4.2.1.4
Financial support for implementation	a) Can help farmers to implement b) Does not necessarily change implementation rate significantly, even though beneficial for farmers	It obviously has to be part of definition of policy to be assessed ex-ante because it would not exist yet. Its actual influence would have to be assessed	4.2.1.8

Opportunity costs (perceived and actual) (other than add. prod. and transaction costs)	Determine costs of compliance	Survey/interviews/calculation Policy specific indicators	4.2.1.2+3
Prices of fertiliser	High prices → farmers tend to calculate thoroughly plant demand and do without security add-ons	Specific indicator for opportunity costs in case study	4.2.1.3.4
Production capacity of sites and cultures	Some suggest relevant correlations in the one or in the other direction but in this case study neither one could be confirmed	Specific indicator for opportunity costs in case study	4.2.1.3.5
Other characteristics of sites and relief	Occurrence of steep slopes and water bodies along fields determine effort for appropriate fertilizer spreading	Specific indicator for opportunity costs in case study	4.2.1.5
Farm structure – overall animal production in the region	A lot of manure to dispose of → using too much manure, using it inappropriately; more difficult fertiliser planning	Specific indicator for costs in case study	4.2.1.4
Farm structure - local concentration of livestock production	Very concentrated animal production spots → wider distribution of manure necessary; → one mistake of large company can have big impact	Specific indicator for costs in case study	4.2.1.4
Attitude of local and regional agricultural agencies towards environment	May determine whether they are too easy or too hard on farmers	Interviews; possibly hard to assess but might in some cases be crucial (if big environmental pressure and large scope to act for executive agencies)	4.1
Benefits (incl. avoidance of sanctions)	Determine overall costs of compliance a) Direct benefits like financial support b) Indirect benefits like avoiding sanctions	Survey/interviews/calculation; Policy specific indicators	4.2.1.1; 4.2.1.8

Information/training measures specifically for respective policy	a) If better knowledge and improvement of skills are facilitated, actors can also see this as benefits. b) Information costs ('transaction costs')	It obviously has to be part of definition of policy to be hypothetically assessed ex-ante because it would not exist yet	4.2.1.8
Height of sanctions	Determines 'costs' of non-compliance	Easily accessible indicator for cost-benefit analysis for compliance behaviour	4.2.1.1.1
Sanctioning regime	Determines what kind of sanctions farmers face and how different farm categories are affected (e.g. CC sanctions more effective for large farms)	Together with height of sanctions easily accessible indicator for cost-benefit analysis for compliance behaviour	4.2.1.1.1
Information asymmetry	Determines how effectively sanctions can be applied; see also 'farm sizes', 'characteristics of resources and transactions'	Can be assessed with indicators e.g.: 'capacity of agencies' (no. and effectiveness of controls), 'characteristics of transactions'; 'farm size'	4.2.1.1.2+ 3
Characteristics of resources and transactions	Determines 'information asymmetry'; see also 'insecurity of transactions'	Qualitative assessment	4.2.1.1.2; 4.2.1.2
Capacities of agencies – no. of controls	Determinant of 'information asymmetry'. The more controls, the less info asymmetry, the more farmers have to take fines into account. But too many controls can have adverse impact, see 'applied rationalities'	Should be easily available indicator for 'information asymmetry'. Just has to be interpreted with care because of rationality dynamics	4.2.1.1.2; 4.2.3
Capacities of agencies –effectiveness of controls (including risk analysis and competency of inspectors)	Determinant of 'information asymmetry', see also 'farm sizes'; 'characteristics of transactions'. More capacity allows for more controls, better risk analysis, higher competency of inspectors, deeper controls.	Indicator for 'information asymmetry'; qualitative assessment	4.2.1.1.2
Concern of non-agricultural inhabitants	a) Determinant of 'information asymmetry' b) In theory could enhance or reduce motivation via social mechanisms – seemingly not in case study	If identified as determinant would need qualitative assessment with interviews	4.2.1.1.2

Perceived probability of getting caught	Determines how serious potential sanctions are taken by actors; Further potential determinants for this are named in the respective section in main text	Indicator for cost-benefit analysis for compliance behaviour; interviews necessary; possibly not crucial in addition to other easier available indicators for 'information asymmetry'	4.2.1.1.3
Attitude towards risk	Determines how potential sanctions are taken into account by actors, but also determinant for decisions on input of e.g. fertilisers or pesticides	Its actual impact depends on the policy case; Interviews/questionnaires	4.2.1.1.4
Transaction costs (perceived and actual)	Determine costs of compliance Determinants: see 'farm sizes', 'education'	Indicators: 'farm sizes',' education' and other policy specific indicators	4.2.1.2+3
Complexity of rules	a) May increase compliance because farmers do not want to risk several small sanctions b) Increases information costs c) May demotivate farmers' compliance because of being overtaxed	Indicator for costs; Indicator for motivation; Qualitative assessment necessary	4.2.1.1.1; 4.2.1.6; 4.2.2.2.2
Quality and accessibility of information (re)sources	Determines a) how good the given information is b) how high information costs are ('transaction costs') c) 'trust' in the information and the policy if described/promoted in/by that (re)source d) how much actors perceive a policy as legitimate ('perceived legitimacy') e) how 'environmental norms' can be shaped by this and internalisation supported	Diverse influences depending on the specific policy. Only restricted use for ex-ante assessment because information of policy will not be distributed yet. But some general aspects can be assessed.	4.2.1.3; 4.2.1.6; 4.2.2.2; 4.2.2.3
Insecurity of transactions	Determines to what degree speculative decisions have to be made, e.g. how much leaching will there be? → how much fertiliser to apply; see also 'attitude towards risk'	Qualitative assessment	4.2.1.2

Approaches towards dealing with bounded rationality	Determines how costs are perceived and taken into account in decision-making For ND: a) strategies to determine how much fertiliser to use b) decisions on 'security add-ons'	May have very different meaning for different policies → individually different ways to assess	4.2.1.2
Economic situation of farms	Can influence how costs are taken into account. E.g. wealthy farms can more easily comply with costly regulations like storage facility requirements, and have more freedom to act upon social rationality	Actual influence in specific case would have to be assessed first.	4.2.1.4
Reputation	May play a role in farmers' willingness to comply in both, an instrumental and a social way, e.g. a) good impression for lessors, inspectors and others b) approval of family and peers	Qualitative assessment of what role reputation plays in a region; Then for indicators see 'environmental awareness of other social groups'	4.2.2.1
Behaviour of others	(De)motivates farmers to comply	Its actual influence in specific case has to be assessed first.	4.2.2.2
Environmental attitudes of other social groups	a) Other groups may have influence on farmers' visible behaviour for instrumental reasons, see 'reputation' b) Other groups may have influence on shaping farmers' personal norms or application of those ('environmental norms')	First their influence has to be assessed. Then depending on group different possibilities to assess; e.g. press evaluation or interviews; overall in the region e.g. elected political parties.	4.2.2.1; 4.2.2.3
Perceived procedural justice and legitimacy of authorities and policies	Influences motivation to comply; on normative but also instrumental basis; see also 'trust'; 'relevance of measures'; actual influence on compliance in case study is uncertain	Specific press evaluation, e.g. magazines of farmers' associations; or interviews; also indicators: 'relationship with local agricultural agency', 'relevance of measures'	4.2.2.2
Relationship with local agricultural agency	See 'perceived procedural justice and legitimacy', and closely connected with 'trust'	Indicator for 'perceived procedural justice and legitimacy'	4.2.2.2

Environmental awareness of farmers	Influences motivation to comply via a) legitimacy b) influence on shaping and internalising 'environmental norms' Crucial for acceptance and compliance beyond economic reasons	Crucial to assess Survey/interviews/calculation	4.2.2.2; 4.2.2.3
Opinion on relevance of measures	Influences 'perceived legitimacy' and motivation to comply; see also 'environmental awareness of farmers'	Survey/interviews	4.2.2.2
Cultural background of actors	Here mostly evident in terms of different reactions of MOL farmers and French farmers on some problems with the rules	Survey/interviews	4.2.2.2
Group identification	Several farmers appreciate Germany trying to be (in their eyes) forerunner in environmental questions	Its actual influence in specific case has to be assessed first. Survey/interviews	4.2.2.2
Environmental norms internalised by farmers	Crucial influences on whether economically unfavourable rules will be followed	Survey/interviews	4.2.2.3
Personal aspects correlated to environmental behaviour	For example, friends who are environmentalists; Some personal aspects could be more structural, for instance if many farmers are also hunters, and are in general more aware and concerned about water quality	Not necessarily usable for ex-ante assessments but if so might offer some easily assessable aspects (like how many farmers are hunters?); However identification of these influences may need high effort	4.2.2.3
Rationality initially applied by farmers	If farmers already apply normative rationality in a way for the environment, they might react adversely on command-and-control policies and vice versa	Qualitative assessment is needed	4.2.3

Trust between actors	In case study: a) Farmers have to trust that demanded strategies are useful b) Farmers have to trust each other in terms of cooperation, esp. manure exchange; thus determinant of 'cooperation potential' c) Trust in authorities' fair procedures and non-arbitrariness is vital for seeing sense in and willingness for compliance	Its specific influence would have to be assessed qualitatively before using it as indicator or general aspect	4.2.1.3.3; 4.2.1.4; 4.2.2.2
Farm structure: Sizes of farms	a) Bigger farms face higher sanctions in case of CC sanctioning regime b) More acreage → more incentive to calculate fertilisation accurately for potential losses c) Less acreage → better overview, higher planning costs per acre → less incentive for accurate planning d) Bigger farms → specialised personnel → less transaction costs for planning, and for information gathering e) Bigger farms → more possibilities to cheat f) Bigger but less farms easier to control in terms of number of controls g) Bigger farms → single mistakes can have big impacts h) Among family farmers approval of peers may matter	'Farm structure – sizes of farms' is an easily available indicator but has very ambiguous influences on different aspects → qualitative assessment of mechanisms for a specific policy must come first; Thresholds for certain effects of farm sizes differ in different regions depending for example on 'educational' factors	4.2.1.3.1; 4.2.1.4; 4.2.1.6; 4.2.2.1
Age of farmers	a) Younger often have more up-to-date education b) Younger farmers may be more flexible c) Younger farmers may be more acquainted with environmental issues due to education, see 'environmental awareness'	Relevance of age would have to be assessed first for each policy case, then usable as indicator for different aspects	4.2.1.3; 4.2.2.3

Education	a) Appreciation of and abilities for accurate calculation and appropriate utilisation b) Ability to gather and process information c) Ability to judge information (possibly working against policy implementation) d) Knowledge and awareness about ecological connections as prerequisite for personal norms	Indicator of several issues (see left); Can have different thresholds, e.g. crucial in case study: agric. education or other, not so much university vs. non-university; also (quality of) 'continuing education'	4.2.1.3.2; 4.2.2.3
Availability of continuing education and training	a) See 'education' b) Training concerning the ND: in MOL probably not so relevant because of many large companies with specialised personnel and good education of farmers in general	Its specific influence would have to be assessed qualitatively before using it as indicator	4.2.1.3.2; 4.2.1.6

Table 2: Overview of aspects and indicators

Annex 2: Explorative Pre-Study

This is a complementation to the presentation of the methodology and results of the pre-study in the main text.

A2.1 Classification of policy option and first CIA list

For PICA a typology has been developed to address the generic structure of policy options which is *"decisive for the range and kind of crucial institutional aspects that can be expected to be conducive or detrimental to the implementation of this policy option."* (SCHLEYER ET AL. 2007a: 28). Of course, in the case of this research it is not a policy option but an actual policy case which has been implemented already.

The first and foremost category in this classification is the policy type. Additionally, the natural resource addressed and the potential property rights change, are considered. The typology and its categories are summed up in figure 6.

The policy type is based on the type of intervention and area of intervention (governance structure). Since the part of the Nitrates Directive regarded here consists mainly of mandatory rules, the type of intervention (x-axis) is *regulatory*. The area of intervention (y-axis) is the *market*, since agricultural companies are addressed which act as independent participants of the market, and their economic performance may be changed by adhering to the rules getting compensated.

The natural resource addressed (z-axis) is *water* as a resource system *"with long-term and diffuse impacts stemming from farming activities"* (SCHLEYER ET AL. 2007a: 37).

And a change of property rights (fourth dimension with the two items displayed as light grey and dark gray) is involved in the sense that farmers' rights to use their property is restricted[17].

[17] Property rights define "who has access to which resources or benefit streams and under what conditions" (VATN 2005a: 253).

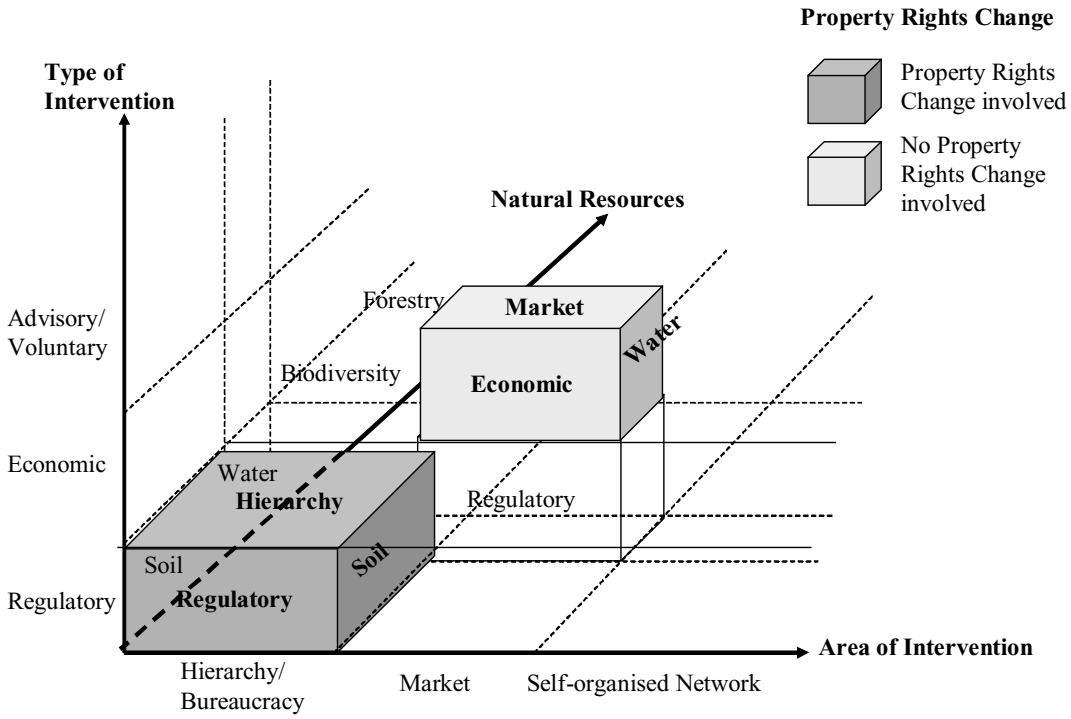

Figure 6: Four dimensions of a policy type (SCHLEYER ET AL. 2007a: 32).

The list of CIA which stems from the classification of the policy case and the CIA library of PICA is presented below in table 3 only as a short enumeration since the CIA relevant for the region were explained in the results section of the main text.

• Ambiguous property rights (more pronounced for New Member States)
• Information asymmetry state vs. firm
• Contradictory policy instruments & rules (joint production)
• Redundant policy instruments & rules
• High level of opportunism
• Monopoly power
• Lack of trust between economic actors
• High administrative public and/or private Transaction Costs
• Weak consumer preferences
• Strong consumer preferences together with high level of social capital
• High level of corruption
• Very large water resource system
• Low incentives to resolve a problem
• High opportunity costs for farmers
• Endowment effect
• Unclear distribution of responsibilities between administrative levels
• Heterogeneous environment-related social values
• Undifferentiated policy measures

Table 3: First list of CIA

A2.1.1 Revised list of CIA based on literature review

To adjust the initial list of CIA to the actual policy case, the first extension of the list was based on a thorough literature review on the implementation of the Nitrates Directive in Germany. Actually, this literature review brought mainly additional CIA. The first list was kept at this stage because there were no serious arguments against any of the aspects. Table 4 shows only a short enumeration of the additional CIA since a comprehensive overview is given in the next section.

• Bargaining power of farmers' organisations
• Attitude of farmers toward ecological considerations
• Bargaining power of environmental groups
• Level of information on policy
• Public concern about water pollution from agriculture
• Importance of the Agro-industrial lobby
• Relevance of measures
• Resources of government agencies
• Complementing policy measures
• Bias of government agencies
• Communication and cooperation between farmers

Table 4: Additional CIA from literature review

A2.1.2 Regional specification of CIA list

The methodology of the final step of the pre-study was explained in the main text (ch. 2), as well as the final results, complemented by findings from the main study (ch. 4.1). The final table of CIA from the pre-study only is shown below in table 5 to make the sources transparent.

Table 5: CIA found in pre-study:

Remarks:

- The numbers in brackets behind the CIA refer to the numbers in the PICA library
- Numbers behind the sources usually refer to the page number in the source
- Explanation of abbreviations:

From Literature	From Interviews
Allier: Schleyer et al. 2007b and/or Amblard et al. 2008 (referring to ex-post test in Allier) Bund: BUND 2007 Breit: Breitschuh: w.y. Brei04: Breitschuh et al. 2004 Brei06: Breitschuh 2006 Brou: Brouwer et al. 2003 Con: Conrad 1992 Eck: Eckert et al. 2000 Ew: Ewers and Henrichsmeyer 2000 Flaig: Flaig et al. 2002 Haa: Haakh 2006 Kers: Kersebaum et al. 2006 KaNe: Kastens and Newig 2007 PICA: PICA CIA library in Schleyer et al. 2007a Puy: Schleyer et al. 2007b and/or Amblard et al. 2008 (referring to real ex-ante in Puy-de-Dome) Scot: mainly Barnes et al. 2007 and other materiel on Scottish NVZ Sko: Skop and Schou 1999	Represented Interviewees: • SeeLaw: local agricultural agency • SeeWas: local water agency (only short conversation over the phone) • P: manager of small family farm • LBV: Referent of regional farmers' association (only short, informal communication on International Green Week 2008) • LUA: Landesumweltamt Brandenburg - State Office for Environment (LUA) • BF: manager of relatively large farm

CIA	Source	Relevance in the region
Information asymmetry state vs. firm (23)	PICA; Allier Puy; Brou (208 D, 71 allg.);Con; Flaig20;74ff Brei04 BUND 2007: 17 Interviews	Matters on the local level
High administrative public transaction costs (2) / Resources of administrations for the implementation of the policy (1)	PICA; Allier Brou; Con87 Haa41; BUND17 Flaig20	Matters on the local level
High level of opportunism (22)	PICA Allier Puy	Matters on the local level but probably not much
Very large water resource system (37)	PICA	Matters on the local level as part of Information asymmetry
Contradictory policy instruments & rules (joint production) (17)	PICA Allier Flaig14ff	Not the case in MOL, in that sense absence does play a positive role
Redundant policy instruments & rules (17)	PICA Allier	Little (distance to water because of pesticides on farm level. WFD on policy level)
Monopoly power (25)	PICA	Not the case
Lack of trust between economic actors (31)	PICA KaNe	Matters on the local level
Private Transaction Costs (7)	PICA Allier	Matters on the local level
Weak consumer preferences (34)	PICA	Was not identified as factor
Strong consumer preferences together with high level of social capital (29) (34) (35)	PICA	Not precisely, but similar with neighbours
High level of corruption (21)	PICA	Improbable
Low incentives to resolve a problem (36)	PICA	Partially true
Perceived opportunity costs for farmers (8)	PICA; Allier Brou (208) Flaig37 Haa40;SeeLaw Paul; Eck; Brei Brei06; Eck	Matters on local level (in some respects positively in others negatively)

Endowment effect (26)	PICA	Not the case
Heterogeneous environment-related social values (33)	PICA	Not so much on the local level
Undifferentiated policy measures (19)	PICA; Kers	In few respects yes
Bargaining power of farmers' organisations (10)	Allier Puy	Not so much on the local level
Bargaining power of environmental groups (8)	Allier Puy	Not the case
Level of information on policy	Allier; Eck; Scot	Matters on the local level
Relevance of measures (2)	Allier; Flaig77 Scot	Matters on the local level
Attitude of farmers toward ecological considerations (8)	Allier; Puy Flaig36	Matters on the local level
Availability of consultation and training	Scot; Ew64 Brou208u Con85 Flaig20;36 Ew64	Absence matters a little on the local level
Interplay between agricultural and environmental administrations (4)	PICA Allier Flaig20	Not so much a problem on the local level directly, but to some degree regionally
Public concern about water pollution from agriculture (3)	Allier	Not directly, but neighbours' concern about manure storage
Importance of the Agro-industrial lobby (3)	Allier Puy	Not the case
Bias of administrations	Con; KaNe Flaig74ff; Ew64 (Haa41ou)	Might matter on the local level
Social Capital	Flaig37 SeeLaw	Matters some for cooperation manure utilisation, self-enforcing rules, and communication
Characteristics of production sites of the region	Breit Eck	Matters on the local level
Agricultural structure – sizes of farms	SeeLaw	Matters on the local level
Agricultural structure – animal production	SeeLaw KaNe	Matters on the local level
Complementing financial measures		Might matter on the local level

Table 5: CIA found in pre-study

Annex 3 References of the annex

Only those which are not in the reference list of the main part are displayed here.

BREITSCHUH, GERHARD. w.y. *Indikatorsystem zur einzelbetrieblichen Analyse und Bewertung der Nachhaltigkeit landwirtschaftlicher Unternehmen*. Online: www.tll.de/ainfo/pdf/osn10703.pdf (last access: 22.04.09).

BREITSCHUH, GERHARD, HANS ECKERT, HARALD FEIGE, ULRICH GERNAND, AND DIETER SAUERBECK. 2004. *Entwicklung eines Umweltcontrolling-/ Umweltoptimierungssystems in der Landwirtschaft*. Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz Und Reaktorsicherheit - Forschungsbericht 201 94 108: UBA-FB 000585. Berlin: Umweltbundesamt.

BREITSCHUH, GERHARD. 2006. *Nachhaltige Düngung und Anbau von Energiepflanzen.* Presentation at the "15. Thüringer Düngungs- und Pflanzenschutztagung" on November 23, 2006 in Pfiffelbach. Online: www.tll.de/ainfo/pdf/dunt1106.pdf (last access: 22.04.09).

FLAIG, HOLGER, HELMUT LEHN, UWE PFENNING, ZERRIN AKKAN, DOROTHEA ELSNER, AND NICOLE WACLAWSKI. 2002. *Umsetzungsdefizite bei der Reduzierung der Nitratbelastung des Grundwassers.* Materialienband. Stuttgart: Akademie für Technikfolgenabschätzung in Baden-Württemberg.

SKOP, E. AND J.S. SCHOU. 1999. Modeling the effects of agricultural production. An integrated economic and environmental analysis using farm account statistics and GIS. *Ecological Economics* 29: 427–442.

Glossary

Calculation strategy: This is the term used for characterising an approach to fertiliser planning which is based on thorough calculations about the optimal fertiliser input with assumed factor values, based on own or representative soil and plant analyses and forecasts of future weather and yields.

Field middens: In this context, temporary storage of livestock manure in the field prior to spreading.

Geselle: A "Geselle" is somebody who has done an apprenticeship in Germany for usually three years. Gesellen have learned a profession mostly practically by working in a company, accompanied by some school education, and have passed an examination to call themselves "Geselle".

Gut strategy: This is the term used for characterising an approach to fertiliser planning which is based on personal observations, impressions, experience, and rules of thumb. To the extreme, it may be based on gut feeling in which information is reflected. "Gut strategy" is naturally an extreme term, only used for illustrative purposes.

Meister: The title "Meister" in a profession in Germany means that after working as Geselle for at least three years, one has acquired further practical and theoretical knowledge, passed respective exams, and is allowed to teach apprentices.

Security-add ons: When farmers have come to an idea of the fertiliser amount required by the plants for their expected growth, they have to decide whether to add additional fertiliser in case factors change favourably and plants could make profitable use of more N. The term is based on Eckert et al.'s (2000) writing about farmers' "safety thinking" in N fertilisation.

State / Bundesland (sing.): Germany is a federal republic and consists of 16 states, which are called "Bundesländer" (plural).

Declaration

Hiermit erkläre ich, die vorliegende Masterarbeit selbstständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt zu haben.

Berlin, den 29.04.2009